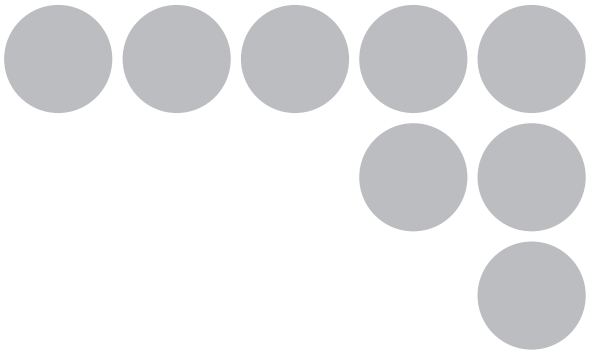
OMRON

Vision Sensor Software for PV Cell Inspection



User's Manual

CAT. NO. Z293-E1-02

Table of Contents

1. About the PV Cell Defect Inspection Software ---------- P.3
    1-1 Overview ---------- P.3
    1-2 Differences with Standard FZ3 Software ---------- P.4
    1-3 Limitations and Precautions ---------- P.4
2. Main Specialized Functions ---------- P.5
    2-1 ADJUST Mode Screen ---------- P.5
        2-1-1 Camera Setting ---------- P.6
        2-1-2 Flow Initialization ---------- P.6
        2-1-3 User Change ---------- P.8
        2-1-4 Area Setting ---------- P.13
        2-1-5 Display Setting ---------- P.13
    2-2 RUN Mode Screen ---------- P.15
    2-3 Focus Adjustment ---------- P.17
    2-4 Lighting Adjustment ---------- P.21
    2-5 Contour Alignment ---------- P.24
    2-6 Busbar Alignment ---------- P.35
    2-7 Outline compensation ---------- P.46
    2-8 Tab Cancellation ---------- P.63
3. Other Specialized Functions ---------- P.67
    3-1 Select ADJUST Mode Screen ---------- P.67
    3-2 PLC Link Function for Communication with Mitsubishi PLC ---------- P.68
    3-3 Calibration Adjustment ---------- P.73
4. Appendix ---------- P.78
    4-1 Processing Items List ---------- P.78
    4-2 Alignment Processing Item (About Coordinate Data) ---------- P.80
5. Revision History ---------- P.81

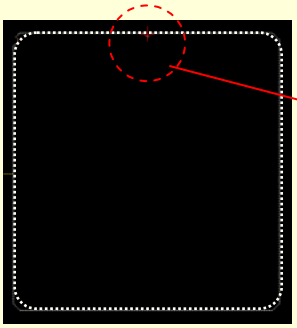
1. About the PV Cell Defect Inspection Software

1-1 Overview

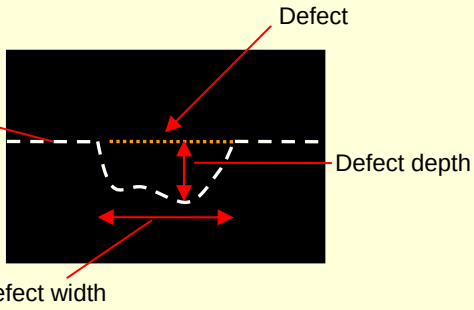
This software is specialized software based on the FZ3 software for inspection of alignment and outline defects on PV cells. In addition to inspection of alignment and outline defects, this software also includes various supplementary features such as focus adjustment and lighting adjustment features that are useful during image adjustment and a change user function that allows for limiting of which settings are adjustable by each user.

○Representative function 1: Outline compensation

Input image



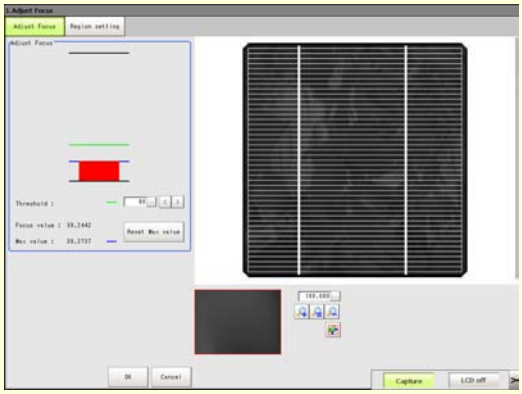
Outline is extracted



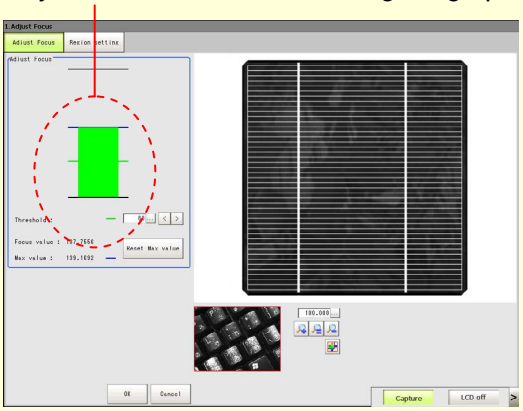
Defects on the outline that are equal to or less than the set width are detected, and the number of defects along with the width and depth of defects are determined.

○Representative function 2: Focus adjustment

Adjust the focus while monitoring the graph and values.



Focus is incorrect



Focus is correct

1-2 Differences with Standard FZ3 Software

This software includes the following specialized features for PV cell defect inspection. Features other than these are identical to features for the standard FZ3 software. See the FZ3 User's Manual for information on these features.

Function name	Function explanation	Page
Main screen (ADJUST mode screen)	Displays buttons for the main specialized functions.	P.5
Main screen (RUN mode screen)	Includes functions for displaying the number of measurements, number of OK judgements, and NG judgements, etc. Also includes a display settings function for easily editing the display contents.	P.15
Focus adjustment Lighting adjustment	The status of focus and lighting settings can be visually monitored through values and a graph.	P.17 P.21
Contour alignment Busbar alignment	Alignment for later processes can be performed to a high degree of accuracy.	P.24 P.35
Outline compensation	Automatically extracts the cell outline and then, while tracing the extracted outline points, detects locations where the perimeter and shape differ with the outline.	P.46
Tab cancellation	Deletes the tabs around the cell through image processing.	P.63
PLC link function for communication with Mitsubishi PLC	In addition to the PLC link function for communication with OMRON PLCs, a PLC link function for communication with Mitsubishi PLCs is included.	P.68
Automatic calibration	Automatically perform calibration with the robot/X-Y-Theta stage coordinate system by inputting the robot or X-Y-Theta stage movement amounts and measuring the reference marks.	P.73

1-3 Limitations and Precautions

[Compatible cameras]
- Only the monochrome cameras listed below are compatible.
  FZ-S/FZ-S2M/FZ-S5M/FZ-SP/FZ-SF

[Compatible controllers]
- Only the controllers listed below are compatible.
  FZ3-L35x/L35x-10,3xx/3xx-10,7xx/7xx-10,FZ4-L35x/L35x-10,6xx/6xx-10,7xx/7xx-10

[Number of usable scenes]
The number of usable scenes differs with that of the standard FZ3 software (28 scenes: 0 to 27).

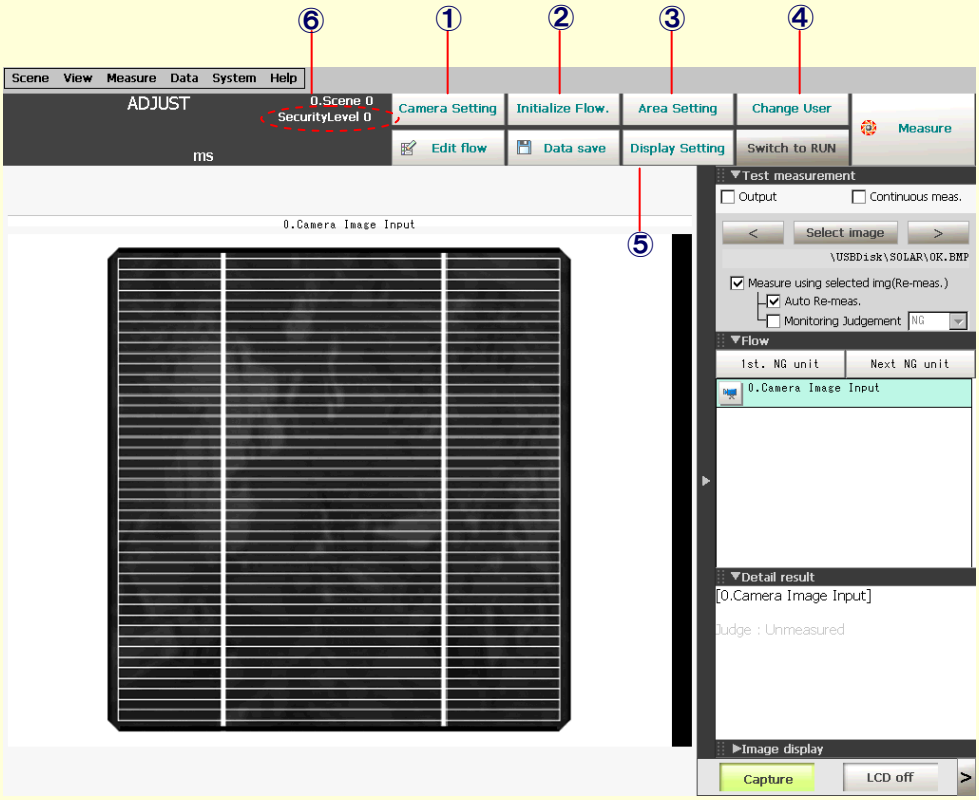
[Number of usable processing items]
This software includes processing items that have been narrowed down from the standard FZ3 software processing items to the items necessary for PV cell defect inspection. For a list of useable processing items, see page 78 of this manual.

[Screen display during adjustment and during operation]
Selecting "Image 1" for the sub image in outline compensation will display a contour image. (Page 56)

Note Please note that displays will take longer to end in comparison with normal displays.

2-1 ADJUST Mode Screen

In order to make the specialized features for defect inspection easier to use, the ADJUST mode screen has buttons for the main specialized functions.



①Camera Setting button

Displays the Camera Setting screen. Adjust the focus, lighting, and calibration of the selected camera. (Page 6)

②Initialize Flow. button

Displays the Initialize Flow. screen. Select items necessary for inspection such as output data and processing units and have these selections reflected in the current flow. (Page 6)

③Area Setting button

Use this button as a shortcut to display the Area Setting screen for the selected processing unit (“Contour alignment”, “Busbar alignment”, “Outline compensation”). (Page 13)

④Change User button

Displays the Change User screen. Change login names, passwords, and manage users at the set security level. (Page 8)

⑤Display Setting button

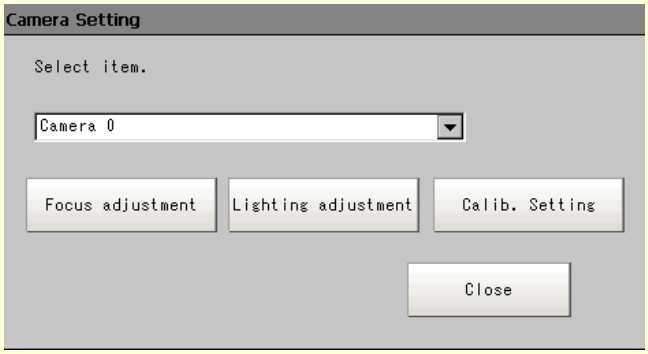
Displays the Display Setting screen. Select the items to be displayed in the RUN mode screen. (Page 13)

⑥Display the security level

Displays the security level for the current user. (Page 8)

2-1-1 Camera Setting

Tap [Camera Setting] in the ADJUST mode screen.
Perform camera focus adjustment, lighting adjustment, and calibration adjustment.



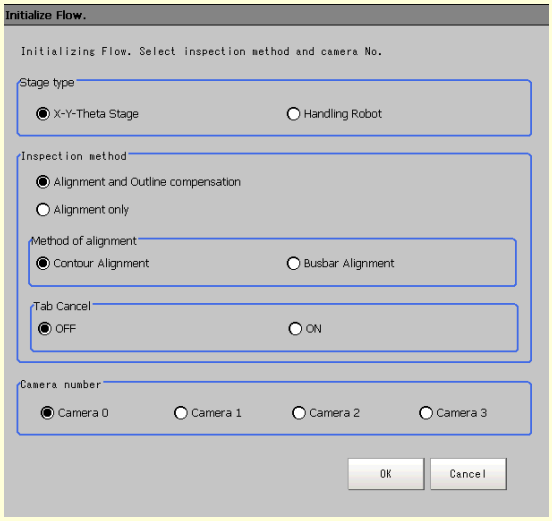
1. Tap [▼] and select the camera number for the camera to adjust.

2. Select what to adjust.

Setting item	Description	Related page
Focus adjustment	Adjust the focus while monitoring the focus values graph.	P.17
Lighting adjustment	Adjust the lighting while monitoring the density within the area.	P.21
Calib. Setting	Perform calibration with the robot coordinate system.	P.73

2-1-2 Flow Initialization

Tap [Initialize Flow.] in the ADJUST mode screen.
Set a basic inspection flow just by selecting inspection items and the camera to be used.
Besides this method, as with the standard FZ3 software, it is also possible to create a unique inspection flow by tapping the [Edit flow] button.

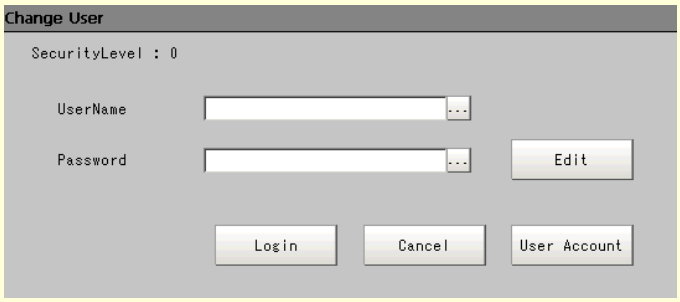


Setting item	Setting value [Factory default]	Description
Stage type	[X-Y-Theta stage]	Select the coordinate system for the data output with the serial data output unit. Reference: Alignment Processing Item (About Coordinate Data) (page 80)
	Handling Robot	
Inspection method	[Alignment and Outline compensation]	Select the processing units to set in the flow.
	Alignment only	
Method of alignment	[Contour Alignment]	Select the edges to be detected in alignment. Contour alignment: Perform alignment using the edge positions of the cell contour. Busbar alignment: Perform alignment using the edge positions of the cell contour and busbars. Reference: Contour Alignment (page 24) Busbar Alignment (page 35)
	Busbar Alignment	
Tab Cancel	[OFF]	Set a unit for cancelling tabs around cells in images only when the inspection item [Alignment and Outline compensation] is selected. OFF: The tab cancel unit is not set. ON: The tab cancel unit is set before outline compensation. Reference: Tab Cancellation (page 63)
	ON	
Camera number	Camera 0	Set Camera 0 as the inspection camera.
	Camera 1	Set Camera 1 as the inspection camera.
	Camera 2	Set Camera 2 as the inspection camera.
	Camera 3	Set Camera 3 as the inspection camera.

Important When flow initialization is performed, the previously set current scene flow will be initialized. To save the flow setting before initialization, perform flow initialization using a new scene or create a scene data backup beforehand.

2-1-3 User Change

Tap [Change User] in the ADJUST mode screen.
Change the login user name, password, and manage other users in accordance with the security level displayed in the upper left.



2-1-3-1 Security Level

A security level can be set for each user to limit the settings parameters for outline compensation, contour alignment, and busbar alignment.

Security level	Description
Security level 0	Settings changes: Only area setting and judgement conditions can be changed. Password management: One's own password can be changed, but passwords of other users cannot be changed.
Security level 1	Settings changes: All settings can be changed. Password management: One's own password can be changed, but passwords of other users cannot be changed.
Security level 4	Settings changes: All settings can be changed. Password management: All users can be managed.

Important Immediately after starting FZ3, the security level is 0. This security level is maintained until either another user logs in or the power is turned OFF. Security levels 2 to 3 are provided for future expansion and are not used with this software.

Important With the factory default settings, the following are registered as the default settings for user information. After changing a user name and password, tap [Data save] to use the new settings.

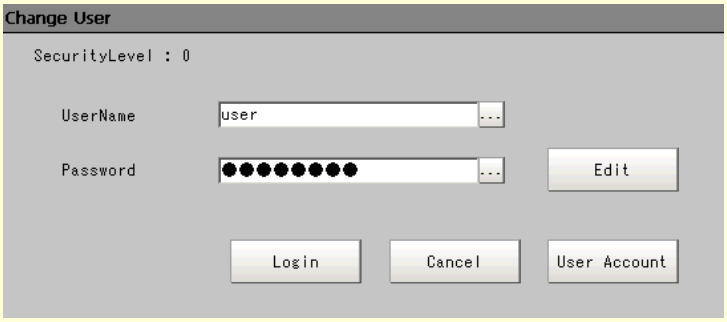
Security level	Default user name	Default password
Security level 0	user	omron
Security level 1	admin	omron
Security level 4	superadmin	omron

Important For user names and passwords, use the characters "0 to 9", "A to Z", and "a to z" set character strings of 4 to 16 characters.

2-1-3-2 Login

1. Tap […].

2. Input a user name and password.



3. Tap [Login].

If the user name and password match, the Change User screen will close and the screen will return to the ADJUST mode screen.

From this point, operation will be performed with the security level set for the user that is logged in.

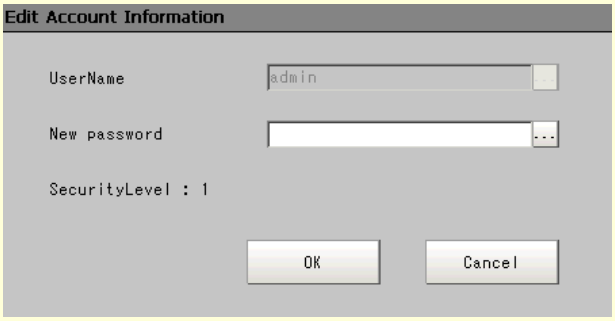
2-1-3-3 Change password

1. Tap […].

2. Input a user name and password.

3. Tap [Edit].

If the user name and password match, the Edit Account Information screen is displayed.



4. Input a new password and tap OK.

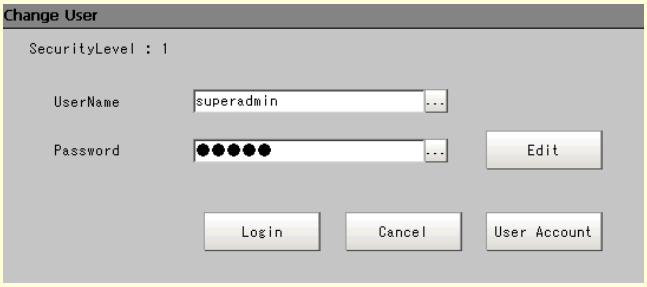
5. In the ADJUST mode screen, tap [Data] - [Data save].

2-1-3-4 Manage Accounts

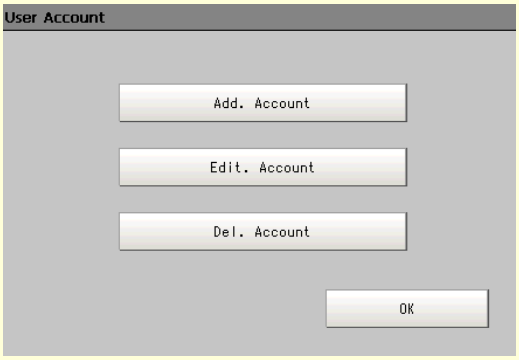
Add, edit, and delete users. This function can only be used by users with security level 4.

1. Tap […].

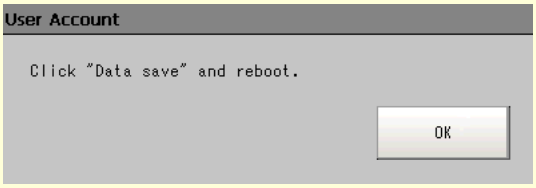
2. Input a user name and password.



3. Tap [User Account].
If the user name and password match, the User Account screen shown below is displayed.
Select what to edit.



4. After editing settings, tap [OK].
A message box is displayed. Tap [OK].



5. In the ADJUST mode screen, tap [Data] - [Data save].

2-1-3-4-1 Adding Accounts

Add more accounts.

1. Tap [Add. Account] in the User Account screen.

2. Input the new user name and password to be added.

3. Tap [▼] and select the security level for the added user.

4. Tap [Regist.]. A message box is displayed.

Note A user name that is identical to an already registered user name cannot be registered. Up to 100 accounts can be registered.

Quick Q&A

Q: How do you check account information (user names, security levels) that has already been registered?
A: Check this information in the Edit. Account screen.

2-1-3-4-2 Editing Accounts

Edit the contents of accounts.

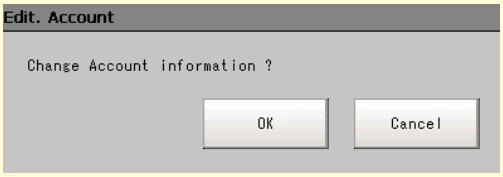
1. Tap [Edit. Account] in the User Account screen.

2. Tap [▼] and select the user name to be edited.

3. To change the password, tap […] and input the new password.

4. To change the security level, tap [▼] and select the new security level.

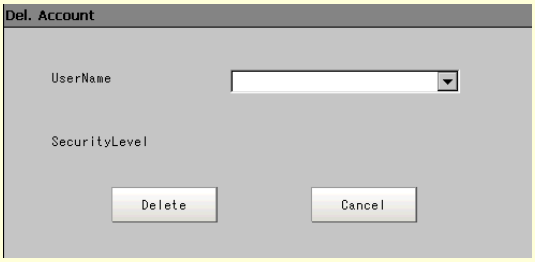
5. Tap [Edit]. A message box is displayed.



2-1-3-4-3 Deleting Accounts

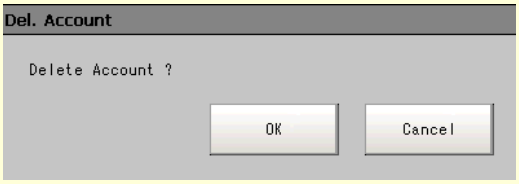
Delete accounts.

1. Tap [Del. Account] in the User Account screen.



2. Tap [▼] and select the user name to be deleted.

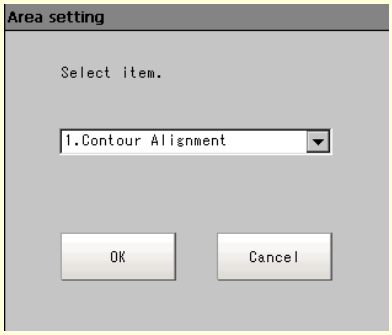
3. Tap [Delete]. A message box is displayed.



2-1-4 Area Setting

Set the area for the selected processing unit (“Contour alignment”, “Busbar alignment”, “Outline compensation”).
Tap [Area Setting] in the ADJUST mode screen.

> **Note** Only one of the processing units “Contour alignment”, “Busbar alignment”, and “Outline compensation” that is registered in the current scene can be selected.



1. Tap [▼] and select the processing unit for performing area setting.

2. Tap [OK]. The Area Setting screen for the selected processing unit is displayed.

For each Area Setting screen, see the pages listed below in this manual.

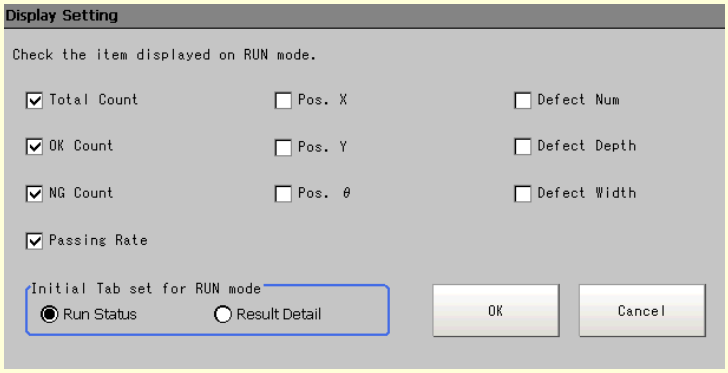
[Contour Alignment] … P.24

[Busbar Alignment] … P.35

[Outline Compensation] … P.46

2-1-5 Display Setting

Select the items to be displayed in the RUN mode screen. Also select the initial state for the RUN mode screen display area.
Tap [Display Setting] in the ADJUST mode screen.



Setting item	Setting value [Factory default]	Description
Item displayed	[Total Count]	Number of times measurement has been performed (0 to 9999999)
	[OK Count]	The number of overall OK judgements from measurement results (0 to 9999999)
	[NG Count]	The number of overall NG judgements from measurement results (0 to 9999999)
	[Passing Rate]	OK Count/Total Count (3-digit integer with 2 decimal digits, Unit: %)
	Pos. X	Detection position X of contour alignment or busbar alignment (-99999.99～99999.99)
	Pos. Y	Detection position Y of contour alignment or busbar alignment (-99999.99～99999.99)
	Pos. θ	Detection angle θ of contour alignment or busbar alignment (-180.00 to 180.00, Unit: degrees)
	Defect Num	Number of defects detected in outline compensation (0 to 100)
	Defect Depth	Depth of defects detected in outline compensation (0 to 99999.99)
	Defect Width	Width of defects detected in outline compensation (0 to 99999.99)
Select screen for RUN mode	[Run Status]	Select the tab that will first display when switching to the RUN mode screen. [Run Status]: Selected items such as Total Count and OK Count are displayed. Result Detail: The same RUN mode screen as the standard FZ3 software is displayed. Reference: RUN mode screen (Page 15)
	Result Detail	

2-2 RUN Mode Screen

There are 2 types of RUN mode screens: "Run Status" and "Result Detail".

2-2-1 Run Status

Items such as the Total Count, OK Count, and NG Count will be displayed in the display area on the right side of the screen.

①Run Status/Result Detail switching tabs

Switch between the "Run Status" and the "Result Detail". The currently selected tab will be displayed in light green.

②Run status list display area

Displays items such as Total Count, OK Count, and NG Count.
Display items can be changed in [Display Setting] on the ADJUST mode screen.(Page 13)

③[Reset] button

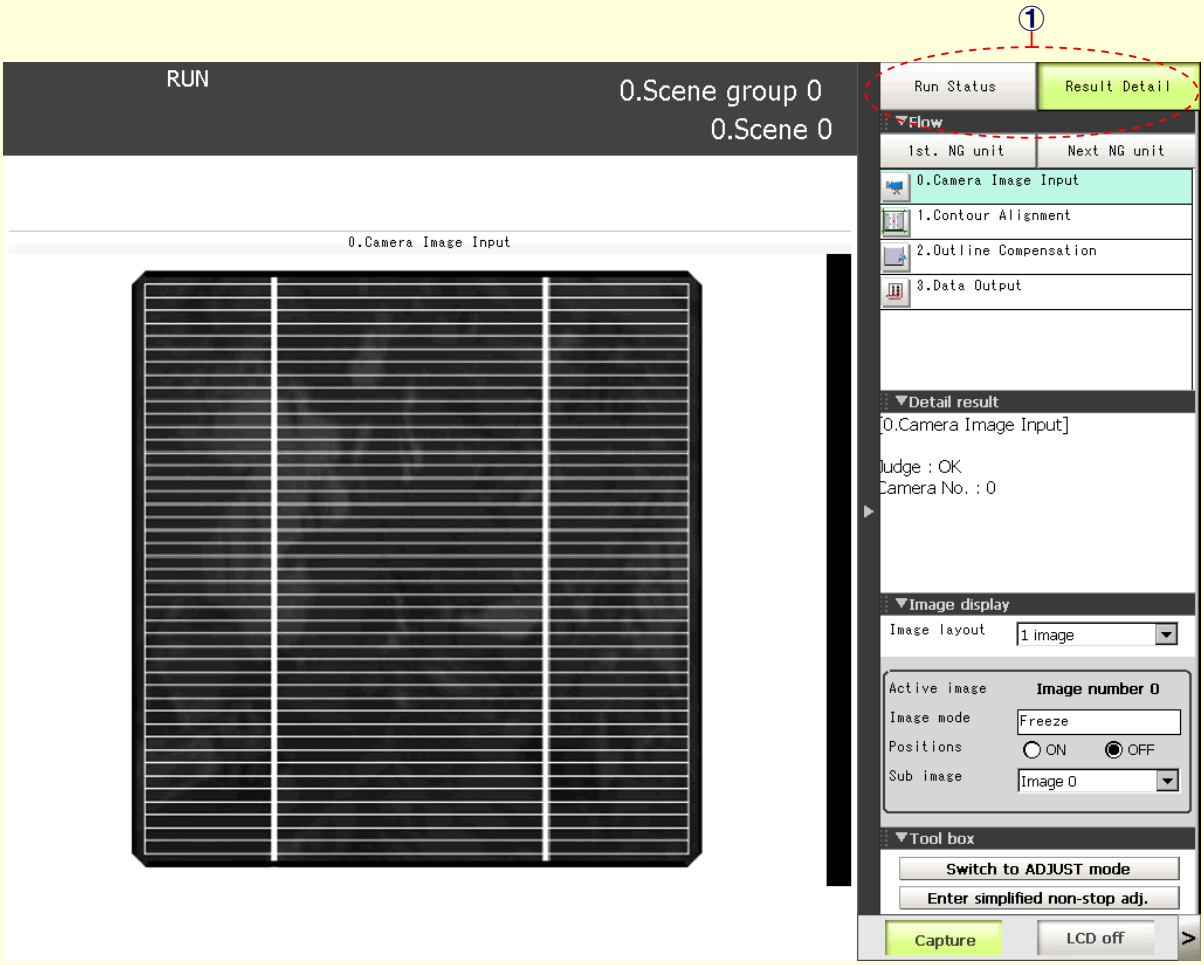
Reset the measurement data in the run status list display area to the initial values (0).

Important

Total Count, OK Count, and NG Count show the number of times for each from the point when the RUN mode screen was opened. The values are reset immediately after starting the system, when switching from the ADJUST mode screen to the RUN mode screen is performed, and when the [Reset] button is pressed.

2-2-2 Result Detail

The RUN mode screen is the same as with the standard FZ3 software.



①Run Status/Result Detail switching tabs

Switch between the "Run Status" and the "Result Detail". The currently selected tab will be displayed in light green.

Note

Contents of the RUN mode screen other than those shown above are the same as with the standard FZ3 software.
See the pages listed below in the standard FZ3 software User's Manual.

Operation Part > Before Operation > Screens/Windows > Main Screen (RUN mode screen)

Quick Q&A

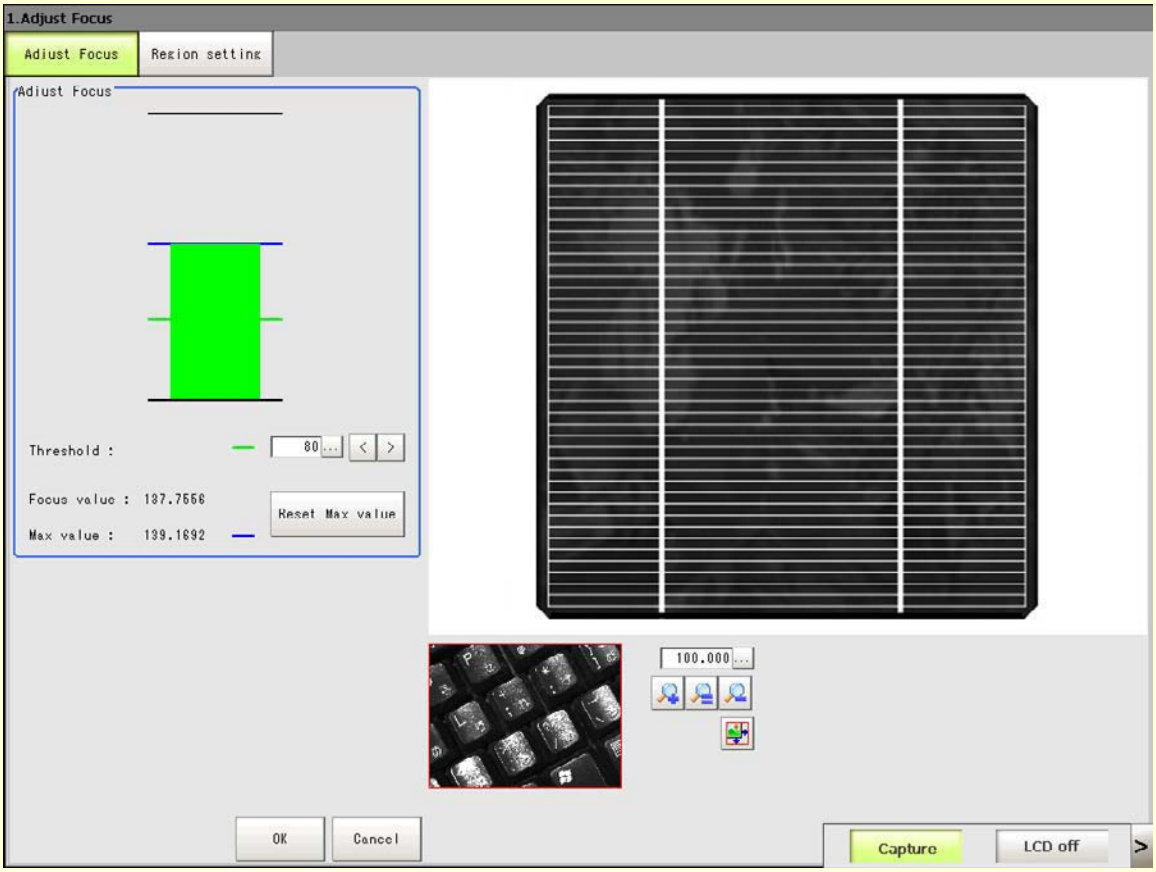
Q: How do you switch from the RUN mode screen to the ADJUST mode screen?
A: After switching to the result detail display, press [Switch to ADJUST mode] in the Tool box area at the lower right of the screen.

2-3 Focus Adjustment

Using the region set within the image, numerically and graphically determine the point at which the focus is correct. Adjust the focus while monitoring the graph.

2-3-1 Adjust Focus

In the Adjust Focus screen, the display will automatically be a through display, and the focus value will always be calculated as images are loaded.



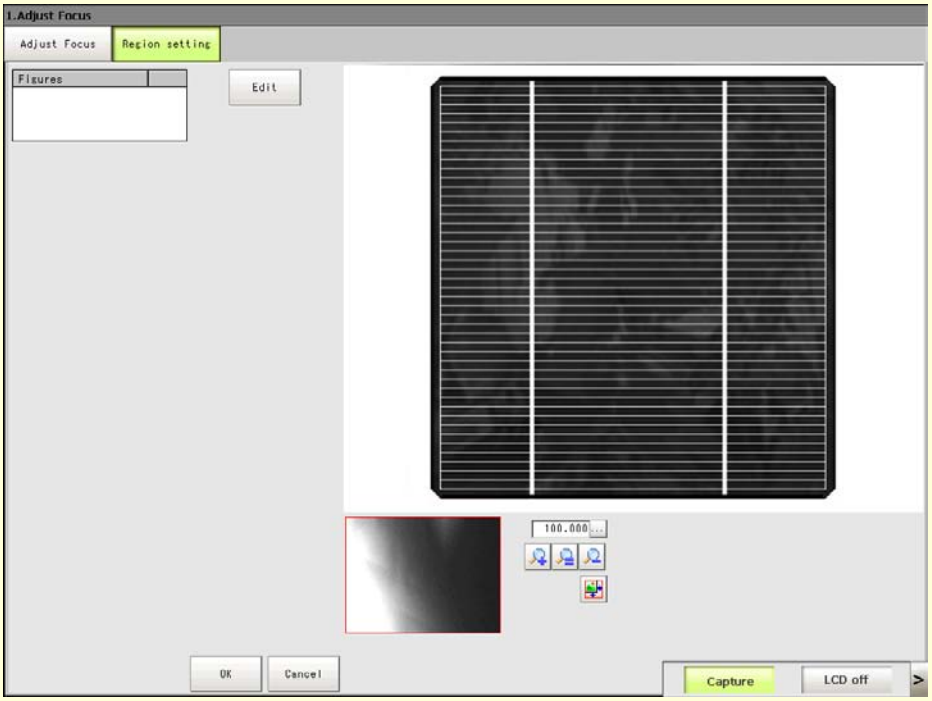
Quick Q&A

Q: What is the focus value?
A: This is a unique OMRON value. This value numerically expresses the sharpness of the edge in the measurement region with a number from 0 to 255. The higher the focus value, the more correct the focus. However, this does not mean the focus is incorrect if the value is not at the maximum value of 255. In addition to the focus, other factors such as the image contrast affect this value, so the ideal value will vary depending on the image conditions.

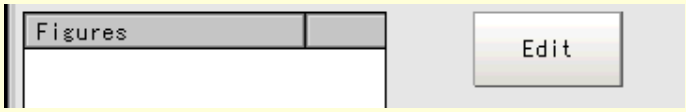
Setting/Display items	Setting value/Display range [Factory default]	Description
Focus value graph	Vertical axis range: 0 to 255	Graph (vertical bar): The current focus value is displayed using height and color. If the focus value is less than the threshold value, the bar is red. If the value is equal to or higher than the threshold value, the bar is green. Green horizontal line: Threshold Blue horizontal line: Max value
Threshold	0 to 255 [80]	Use this value as a guide when adjusting the focus.
Focus value	0 to 255	Displays the current focus value. The higher this value, the more correct the focus.
Max value	0 to 255	Displays the maximum focus value since starting the system to the current point.
Reset Max value		Initializes the max value to 0.

2-3-2 Region Setting

Set the region where the focus will be adjusted.



1. Tap [Edit].



2. Select the figure to register and edit the region.

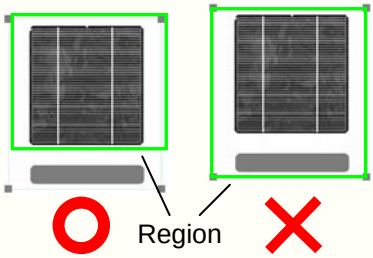
Note

For operation of the Figures Setting Area screen, see the page listed below in the standard FZ3 software User's Manual.

Environment Setting Part > Appendix > Setting Figures > Layout of Figure Setting Area

Important

If there are objects with different heights than the measurement object, perform region setting so that these objects are excluded.



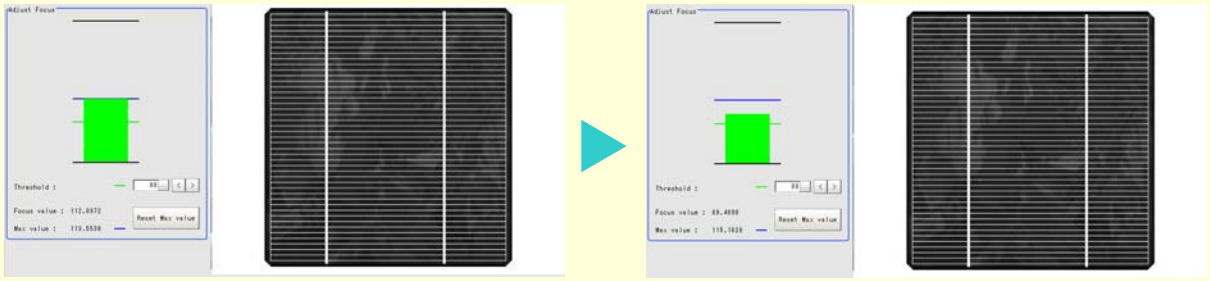
2-3-3 Focus Adjustment

This section indicates the specific procedure to adjust the focus.

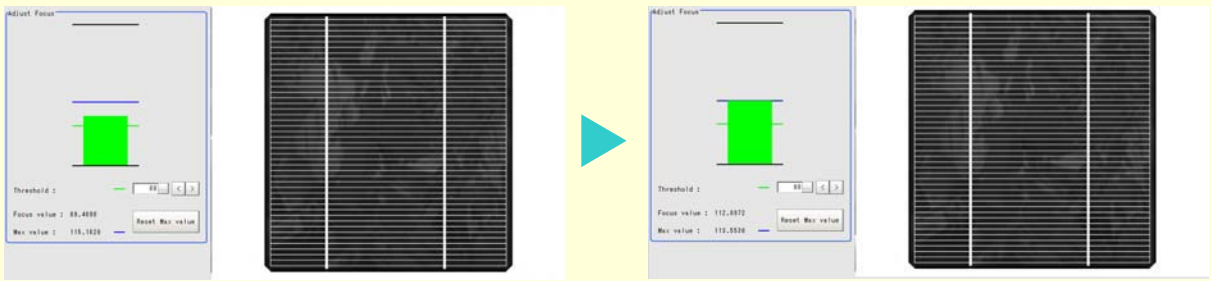
1. **Before displaying the Adjust Focus screen, move the lens focus so that it is either at the nearest position or the farthest position.**
2. **Display the Adjust Focus screen.**

3. **Slowly move the lens focus in one direction. The focus value will gradually increase.**

4. **If the lens focus is continually moved in one direction, the focus value will reach a maximum value at one point and will then begin to decrease.**



5. **If the focus value beings to decrease, next move the lens focus in the opposite direction, and adjust the focus so that the focus value is near the maximum value in the end.**

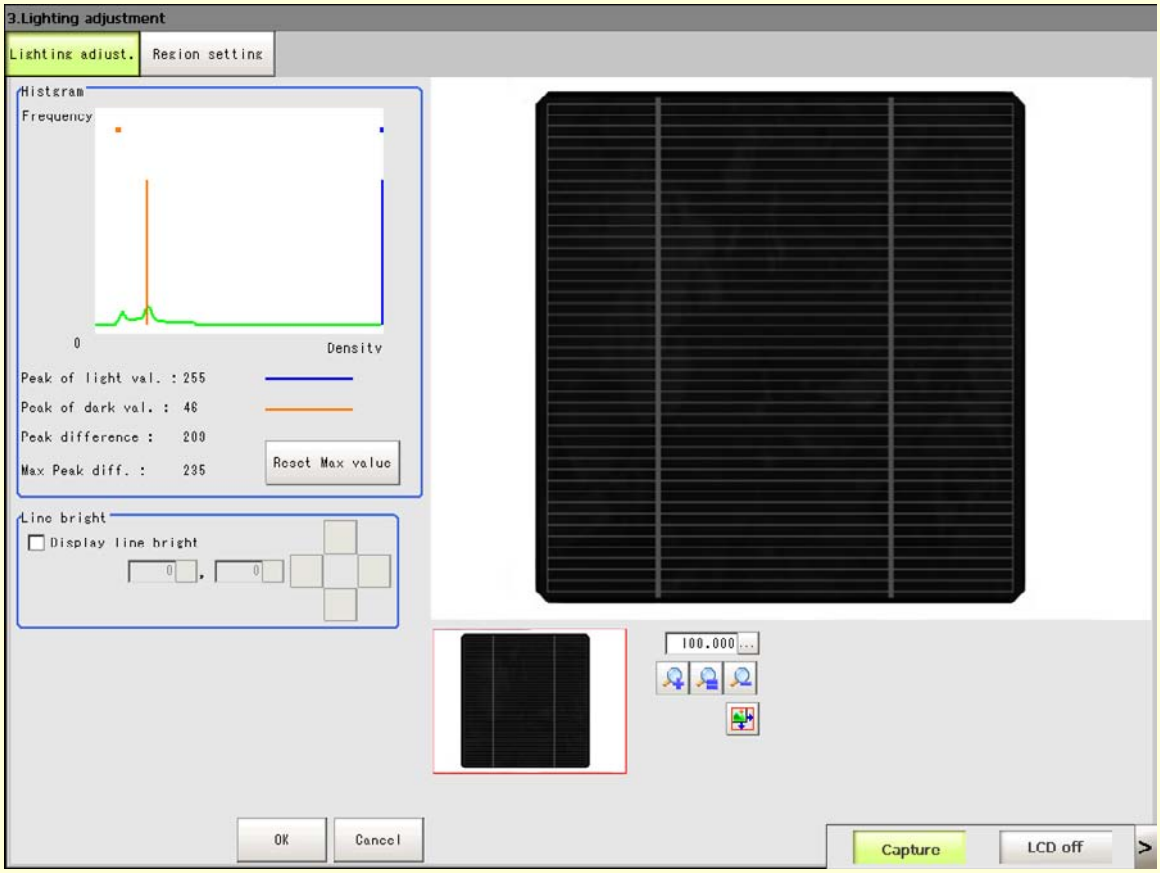


2-4 Lighting Adjustment

The density distribution within the set region is displayed with a graph. Through numerical and graphical representation of the peak positions and peak differences of the cell background density and the cell density, anyone can perform lighting adjustment, which was previously performed based on experience and feel, in the same manner in a short time.

2-4-1 Lighting Adjustment

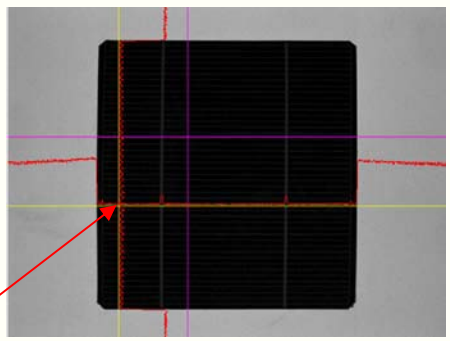
In the Lighting adjustment screen, the display will automatically be a through display, and the density distribution will always be calculated as images are loaded. From the density distribution, the density distributions of the background and cell are automatically divided from each other and the density peak values and the difference between these values (density peak difference) for each are calculated.



Setting/Display items	Setting value/Display range [Factory default]	Description
Histogram	Vertical axis range: 0 to 100%	- Green broken line: Current histogram - Vertical axis: Number of pixels for each density value (maximum is 100%) - Horizontal axis: Pixel density (0 to 255) - Blue vertical line: Current background density peak value - Red vertical line: Current cell density peak value - Upper blue point: Background density peak value when the peak difference between the cell density and background density were at a maximum. Use this value as a guide when adjusting. - Upper red point: Cell density peak value when the peak difference between the density of the cell and the density of the background were at a maximum.
Peak of light val.	0 to 255	This is the peak density in the density of the background.
Peak of dark val.	0 to 255	This is the peak density in the density of the cell.
Peak difference	0 to 255	This value is determined by subtracting the Peak of the dark val. from the Peak of light val. Generally, the higher this value is, the higher the contrast between the background and the cell and the better conditions are for cell defect inspection.
Max Peak diff.	0 to 255	Displays the maximum value for the peak difference since starting the system to the current point.
Reset Max value		Initializes the Max Peak diff. to 0.
Display line bright		Displays a line bright on the image.

Note

A graph showing the density change for 1 line in the image is called a "Line bright". Density change graphs can be displayed for any horizontal or vertical line.



Red line: Indicates the density change graph.

Purple line:Indicates the density maximum value (255).

Select the desired point for the line bright to display.

Yellow line (reference line)

The line bright is displayed on this line. Also indicates the line on the graph where density is 0.

2-4-2 Region Setting

Select the region to use in lighting adjustment.
Reference: Region Setting in Focus Adjustment section (page 17)

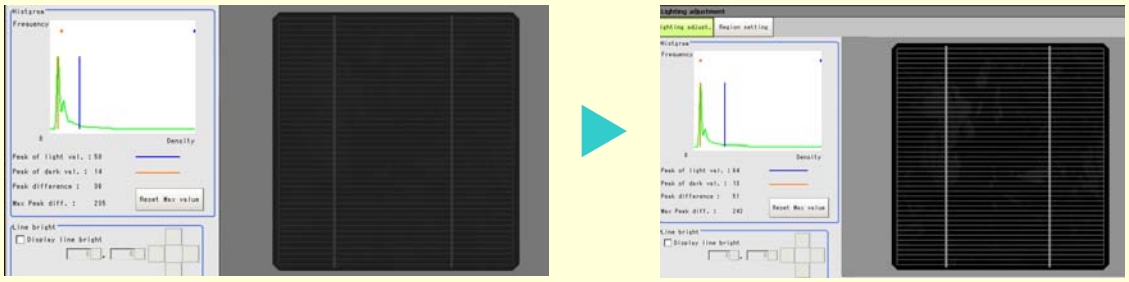
2-4-3 Lighting Adjustment

This section indicates the specific method to adjust lighting.

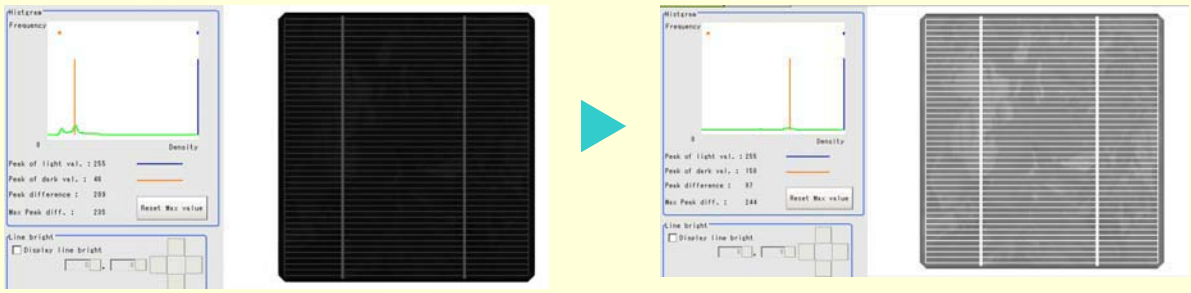
1. Set the light volume (or lens aperture) for lighting to dark (or bright).

2. Display the Lighting adjustment screen.

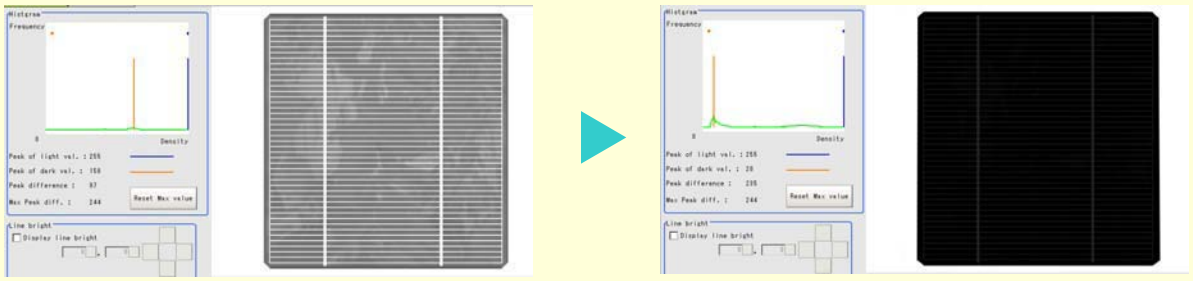
3. If the light volume for lighting is gradually moved in one direction toward being brighter, the peak difference will increase.



4. If the lens focus is continually moved in one direction towards being brighter, the peak difference will reach a maximum value at one point and will then begin to decrease.



5. When the peak difference begins to decrease, make the light volume (or lens aperture) darker and make adjustments so that the peak difference is near the maximum peak difference in the end.



Note

The peak difference will be higher the closer the background is to a state where there is halation (density of 255). However, when halation is actually occurring, density information of 255 or higher may disappear. Depending on the situation, there may be instances where the degree of defects may be more stable when halation is not occurring, so use the maximum peak difference as a guide for adjustment.

2-5 Contour Alignment

Edge position measurement is performed at multiple locations along with the contour of the cell and the necessary value for alignment is automatically calculated.

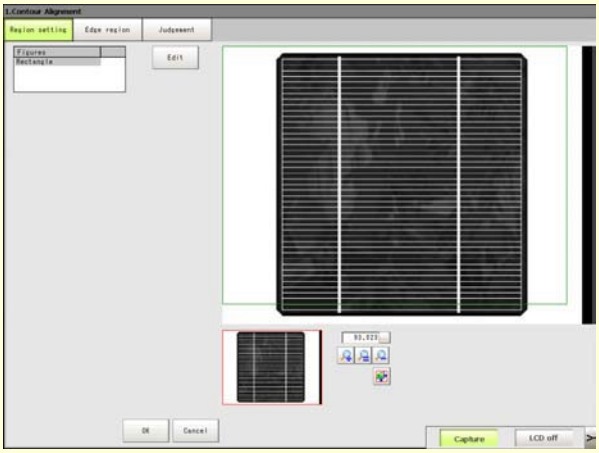
Note

In contour alignment, first perform edge position measurement at multiple locations to determine approximated line. Determine the vertices of a circumscribed rectangle from the intersections of the approximated lines to measure the center coordinates and the slanting of the cell.

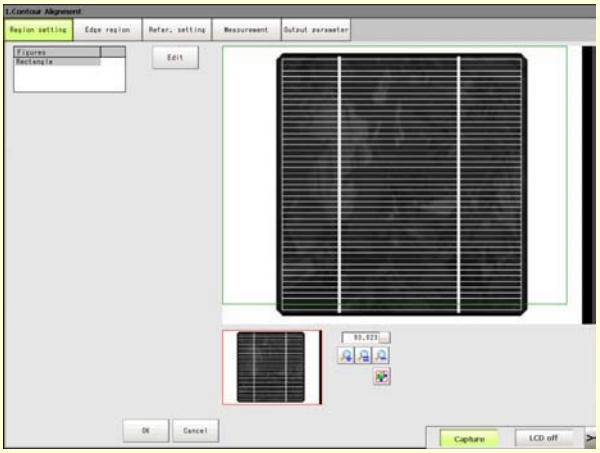
2-5-1 Menu Structure

The tabs displayed (parameters that can be set) will vary depending on the security level.

Security level 0



Security level 1 or higher



(○: Can be set, ×: Cannot be set)

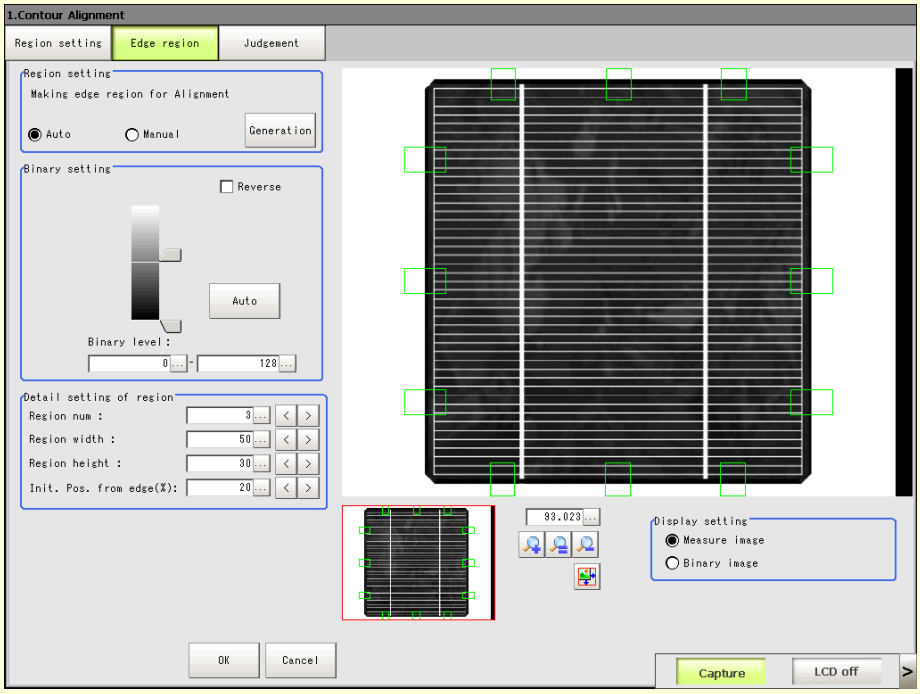
Tabs where setting is possible	Security level		Description
	Level 0	Level 1 or higher	
Region setting	○	○	Set the entire region for contour alignment.
Edge region	○	○	Set the edge measurement region. It is possible to set multiple regions using the automatic generation button.
Refer. setting	×	○	Select the reference axis for the output angle.
Measurement	×	○	With security level 1 or higher, set the judgement conditions or edge position measurement parameters in this screen. Normally, the factory default value will be used.
Output parameter	×	○	Select output parameters to specify how to handle the coordinates.
Judgement	○	×	With security level 0, set the judgement conditions in this screen.

2-5-2 Region Setting

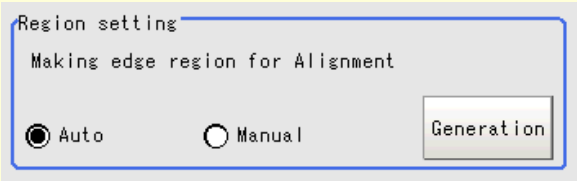
Set the entire region to be used in contour alignment.
Reference: Region Setting in Focus Adjustment section (page 17)

2-5-3 Edge Region

Set the edge regions for calculating the center coordinates and slanting of the cell. At the point the settings screen is entered, the edge regions are automatically set in accordance with the cell position. Adjust the region as necessary for reasons such as automatically generated regions overlapping with tabs, etc.



1. Set the measurement region.

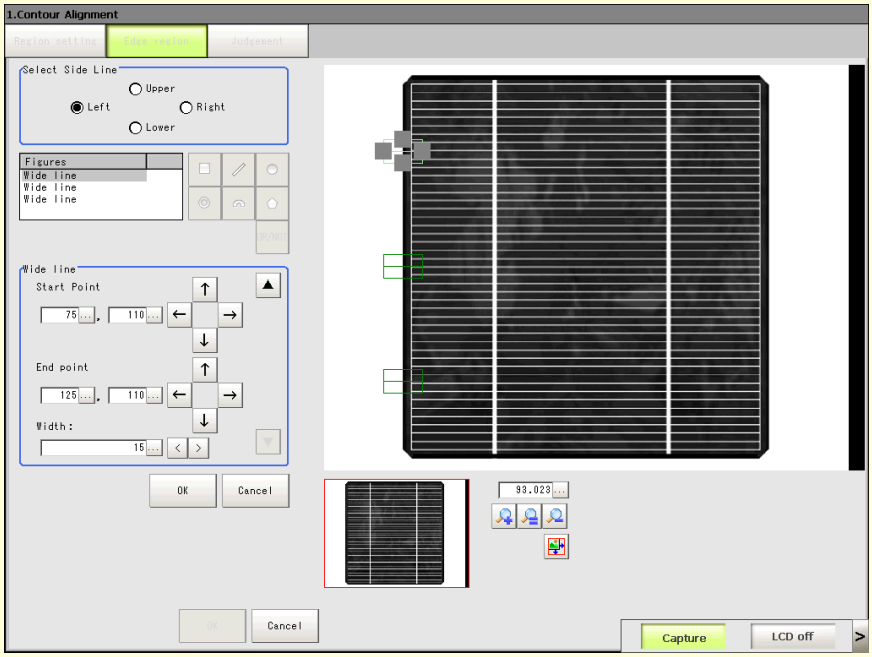


Setting	Setting value [Factory default]	Description
Region setting	[Auto]	Set the edge regions automatically according to the settings in Binary setting and Detail setting of region.
	Manual	Set each edge location region manually.
Generation		Set according to the selected contents in Region setting. When set to Auto: Regions are set automatically. When set to Manual: The manual region setting screen is displayed.

Note When edge regions are set manually, set regions after setting the number of regions in Detail setting of region.

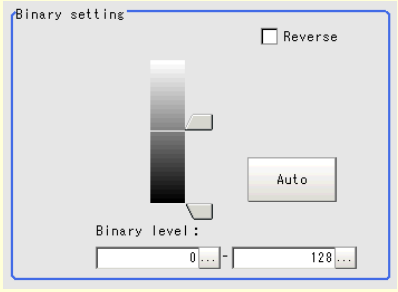
○When the [Generation] button is pressed with the Manual setting

Select the side line to adjust with [Select Side Line]. The edge regions of the selected side line are displayed, so adjust the figure of the regions as required.



1. Adjust the binary level as required.

Use the binary image to extract the outline (side line), and generate an edge region on that side line.



Setting		Setting value [Factory default]	Description
Binary level	Lower limit value (Left)	0 to 255 [0]	Adjust the binary level so that the measurement object is converted to white pixels.
	Upper limit value (Right)	0 to 255 [128]	
Auto			Automatically optimize the binary level according to the image.
Reverse			Invert black and white in the binary image.

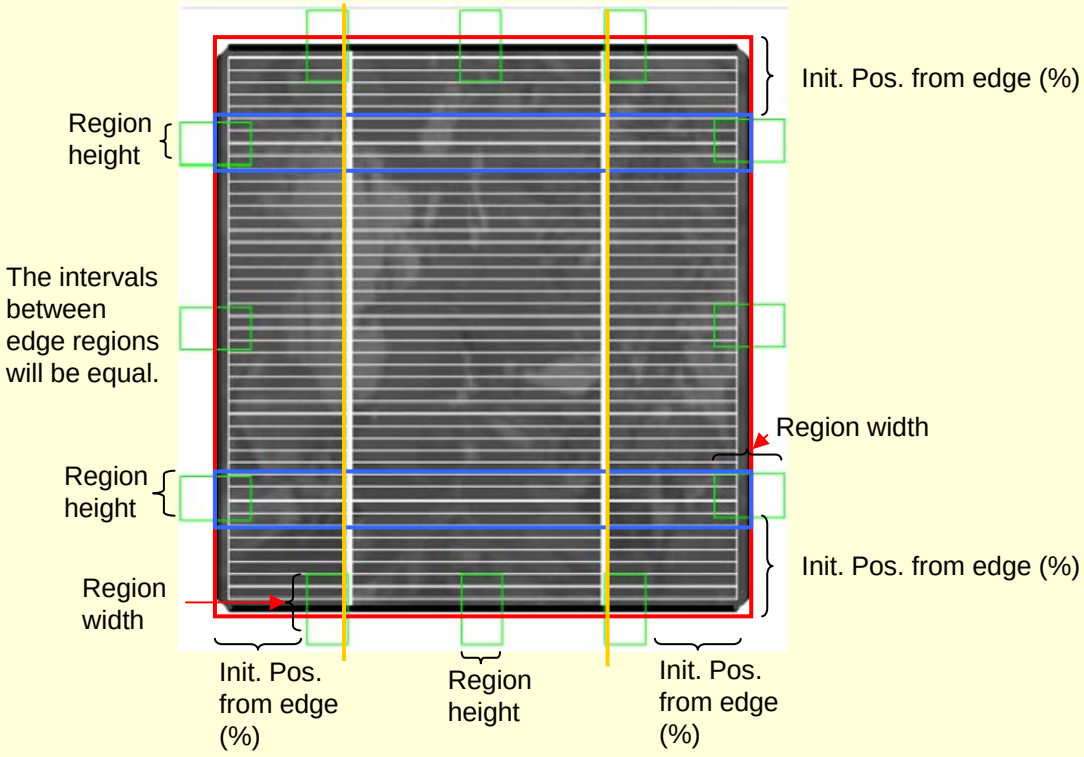
2. Adjust Detail setting of region as required.

The edge regions in automatic generation will be set according to the setting contents. Adjust the settings to make the size of automatically generated edge regions larger, etc.

Setting	Setting value [Factory default]	Description
Region num	2 to 5 [3]	Set the number of edge regions on one side line.
Region width	2 to 200 [50]	Specify the width (length) of the edge detection direction. (Unit: pixels)
Region height	1 to 200 [30]	Set the height (length) of the edge detection direction and vertical direction. (Unit: pixels)
Init. Pos. from edge	0 to 49 [20]	Use a percentage to specify the position at which an edge region will be generated based on the length of one side line of the cell outline. (Unit: %)

○When the [Generation] button is pressed with the Auto setting.

Regions will be automatically generated as shown below according to the parameters in Detail setting of region.(When Region num is 3)



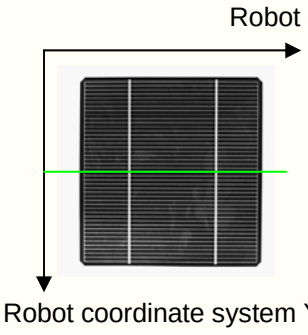
2-5-4 Refer. Setting (only for security level 1 or higher)

Match the calibration axes and output-angle on the display.

1. Select a reference axis as required.

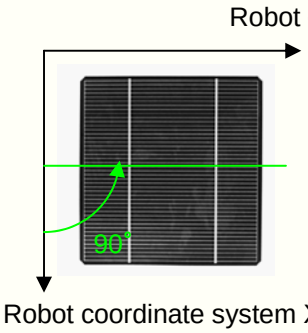
Setting	Setting value [Factory default]	Description
Reference axis	[X-axis (0 degree)]	Output the angle as is without correcting it.
	Y-axis (-90 degree)	Output the angle after reducing it by 90 degrees.
	X-axis (+/-180 degree)	Output the angle after reducing it or increasing it by 180 degrees.
	Y-axis (+90 degree)	Output the angle after increasing it by 90 degrees.

Note Adjust the reference axis in the following cases.



In the case of a coordinate system like the one shown on the left, the line angle of the green line that indicates tilting of the cell is 0 degrees because it is parallel with the X axis, and it matches with what is seen on the display.*

In the case of this kind of coordinate system, select the default setting X-axis (0 degree).



In the case of a coordinate system like the one shown on the left, the line angle of the green line that indicates tilting of the cell is 90 degrees in relation to the X axis, and it does not match with what is seen on the display.*

In the case of this kind of coordinate system, select Y-axis (-90 degree).

* If the cell is not tilted in the image

2-5-5 Measurement (only for security level 1 or higher)

Set the judgement conditions or edge position measurement parameters.

1. Set the judgement conditions.

Setting	Setting value [Factory default]	Description
Center position X	-99999.9999 to 99999.9999 [-10.0000 to 10.0000]	Set the range to be judged as OK for the cell center position X.
Center position Y	-99999.9999 to 99999.9999 [-10.0000 to 10.0000]	Set the range to be judged as OK for the cell center position Y.
Angle	-180 to 180 [-10 to 10]	Set the range to be judged as OK for the cell angle.

2. Adjust the edge measurement parameters.

Note

In detailed settings in Measurement, edge position is the same as with the standard FZ3 software.

See the page listed below in the standard FZ3 software Processing Items List Manual.

Processing Items List > Inspection and Measurement > Edge Position > Measurement (Edge Position)

2-5-6 Output Parameter (only for security level 1 or higher)

In the Output parameter screen, select how to treat the values to be output to the external device as measurement results.

1. Select output parameters as required.

Setting	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	Select whether to output coordinate values before or after the position compensation is performed.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. -ON: Output the coordinate values converted into actual dimensions. -OFF: Output the camera coordinate values (Unit: pixels).
Reflect to overall judgement	[ON] OFF	Select whether to have the judgement result of the processing unit reflected in overall judgement.

Note

If Contour Alignment is registered with [Initialize Flow], calibration is automatically set to [ON].

2-5-7 Judgement (only for security level 0)

Set the judgement conditions.

1. Set the judgement conditions.

Setting	Setting value [Factory default]	Description
Center position X	-99999.9999 to 99999.9999 [-10.0000 to 10.0000]	Set the range to be judged as OK for the cell center position X.
Center position Y	-99999.9999 to 99999.9999 [-10.0000 to 10.0000]	Set the range to be judged as OK for the cell center position Y.
Angle	-180 to 180 [-10〜10]	Set the range to be judged as OK for the cell angle.

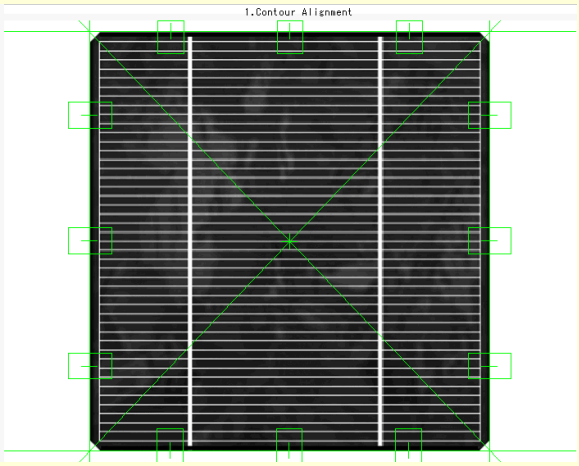
2-5-8 Display the Measurement Results

This section explains the contents of the Contour Alignment measurements results display shown in the RUN mode screen and ADJUST mode screen.

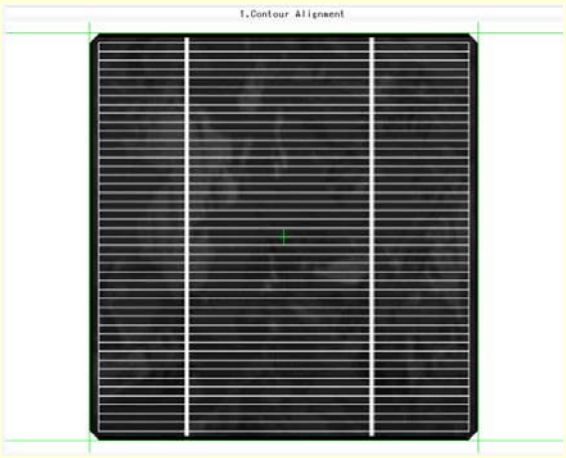
2-5-8-1 Image Display

Depending on the sub image number, the following kind of display will be seen.

Sub image No.: Image 0



Sub image No.: Image 1

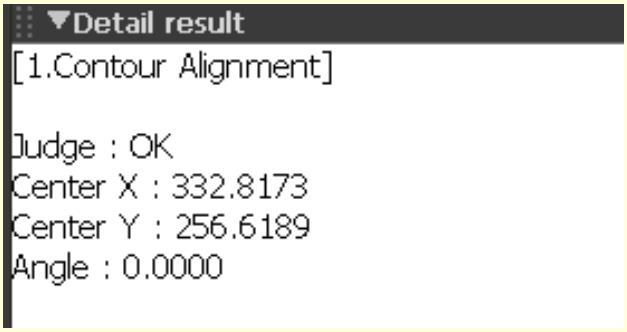


(○: Displays, X: Does not display)

Display item	Type	Sub image No.		Position list display	Description
		0	1		
Center position	Crosshair cursor	○	○	○	Displays the cell center position.
Approximated line	Line	○	○	○	Displays the approximated line for each side line.
Edge position	Crosshair cursor	×	○	×	Displays the edge positions of the edge regions on each side line.
Edge region	Wide line	×	○	×	Displays the edge regions on each side line.
Diagonal line	Line	×	○	×	Displays the diagonal lines of the circumscribed rectangle calculated from the intersections of the approximated lines for each side line.

2-5-8-2 Display the Detailed Results

The display the detailed results for contour alignment will be displayed as shown below.



Display item	Display range	Description
Judge	OK/NG/Not yet measured	Displays the unit judgement result.
Center X	-99999.9999 to 99999.9999	Displays the X coordinate for the cell center position.
Center Y	-99999.9999 to 99999.9999	Displays the Y coordinate for the cell center position.
Angle	-180 to 180	Displays the cell angle.

2-5-9 Environment Setting (External Refference Tables)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Output range	Description
Judgement	JG	1, 0, -1	Unit judgement result. 1: OK -1: NG 0: Not yet measured
Center position X	X	-99999.9999 to 99999.9999	X coordinate of the measured cell center position.
Center position Y	Y	-99999.9999 to 99999.9999	Y coordinate of the measured cell center position.
Angle	TH	-180 to 180	Cell tilting angle.
X coordinate after rotation correction	RX	-99999.9999 to 99999.9999	X coordinate after rotation correction by “angle” amount in X-Y-Theta stage.
Y coordinate after rotation correction	RY	-99999.9999 to 99999.9999	Y coordinate after rotation correction by “angle” amount in X-Y-Theta stage.
Upper left X coordinate of 4 cell vertices	C1X	-99999.9999 to 99999.9999	Upper left X coordinate of the measured cell circumscribed rectangle.
Upper left Y coordinate of 4 cell vertices	C1Y	-99999.9999 to 99999.9999	Upper left Y coordinate of the measured cell circumscribed rectangle.
Lower left X coordinate of 4 cell vertices	C2X	-99999.9999 to 99999.9999	Lower left X coordinate of the measured cell circumscribed rectangle.
Lower left Y coordinate of 4 cell vertices	C2Y	-99999.9999 to 99999.9999	Lower left Y coordinate of the measured cell circumscribed rectangle.
Upper right X coordinate of 4 cell vertices	C3X	-99999.9999 to 99999.9999	Upper right X coordinate of the measured cell circumscribed rectangle.
Upper right Y coordinate of 4 cell vertices	C3Y	-99999.9999 to 99999.9999	Upper right Y coordinate of the measured cell circumscribed rectangle.
Lower right X coordinate of 4 cell vertices	C4X	-99999.9999 to 99999.9999	Lower right X coordinate of the measured cell circumscribed rectangle.
Lower right Y coordinate of 4 cell vertices	C4Y	-99999.9999 to 99999.9999	Lower right Y coordinate of the measured cell circumscribed rectangle.

◎External Reference Table

No.	Data name	Get/Set	Data range
0	Judgement	Get only	1: OK -1: NG 0: Not yet measured
5	Center position X	Get only	-99999.9999 to 99999.9999
6	Center position Y	Get only	-99999.9999 to 99999.9999
7	Angle	Get only	-180 to 180
8	X coordinate after rotation correction	Get only	-99999.9999 to 99999.9999
9	Y coordinate after rotation correction	Get only	-99999.9999 to 99999.9999
10	Upper left X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
11	Upper left Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
12	Lower left X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
13	Lower left Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
14	Upper right X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
15	Upper right Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
16	Lower right X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
17	Lower right Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
101	Output coordinates	Get/Set	0: After scroll 1: Before scroll
102	Calibration	Get/Set	0: Calibration OFF 1: Calibration ON
103	Reflect to overall judgement	Get/Set	0: ON 1: OFF
121	Binary level upper limit value	Get/Set	0 to 255
122	Binary level lower limit value	Get/Set	0 to 255
123	Reverse	Get/Set	0: OFF 1: ON
124	Edge region width	Get only	2 to 200
125	Edge region height	Get only	1 to 200

No.	Data name	Get/Set	Data range
128	Measurement region generation position	Get only	0 to 49
129	Center position X judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
130	Center position X judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
131	Center position Y judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
132	Center position Y judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
133	Angle judgement upper limit value	Get/Set	-180 to 180
134	Angle judgement lower limit value	Get/Set	-180 to 180
136	Number of edge regions	Get only	2 to 5

2-6 Busbar Alignment

Edge position measurement is performed at multiple locations along with the contour of the cell and the busbars and necessary values for alignment is automatically calculated.

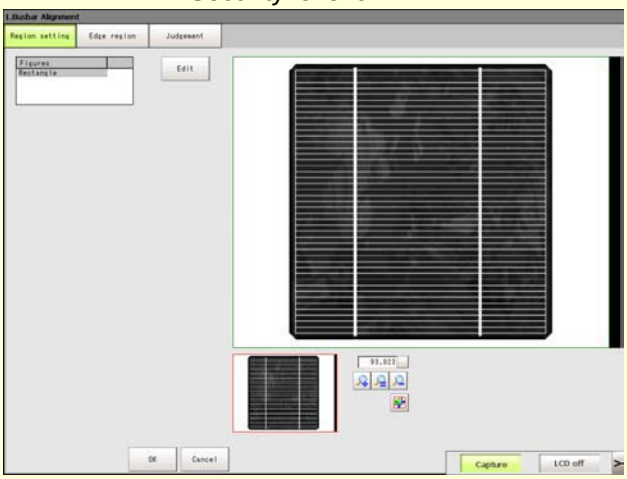
Note

In busbar alignment, first perform edge position measurement at multiple locations to determine approximated line. Determine the vertices of a circumscribed rectangle from the intersections of the approximated lines to measure the center coordinates and the slanting of the cell.

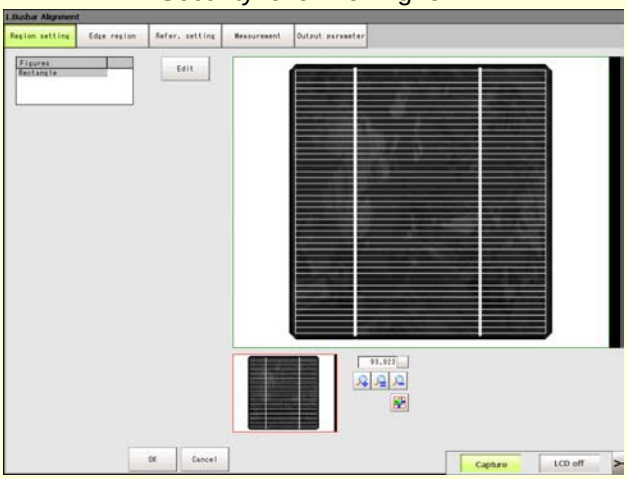
2-6-1 Menu Structure

With busbar alignment processing units, the tabs displayed (parameters that can be set) will vary depending on the security level.

Security level 0



Security level 1 or higher



(○: Can be set, X: Cannot be set)

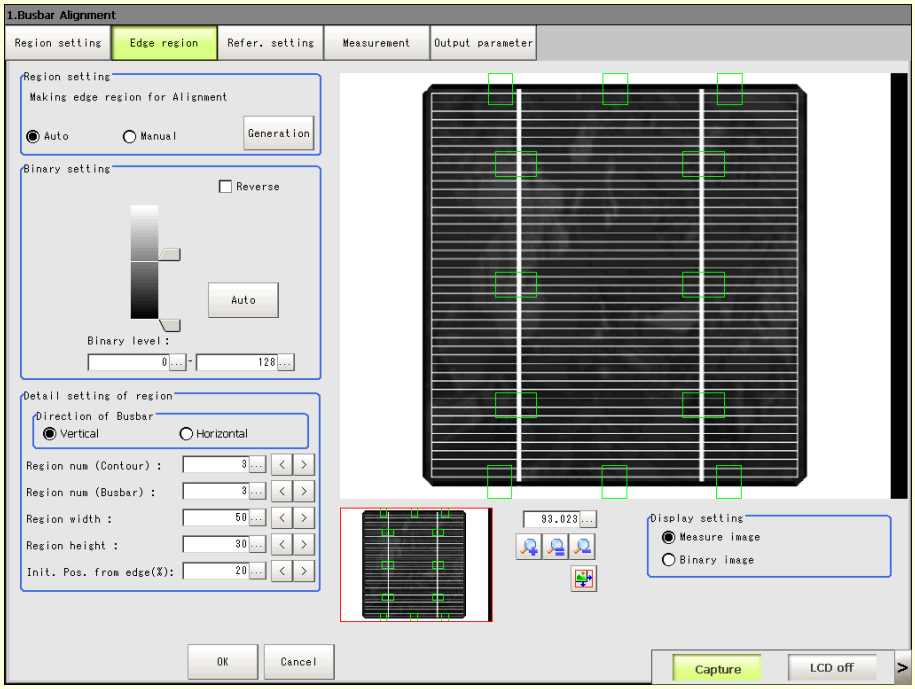
Tabs where setting is possible	Security level		Description
	Level 0	Level 1 or higher	
Region Setting	○	○	Set the entire region for busbar alignment.
Edge region	○	○	Set the edge measurement region. It is possible to set multiple regions using the automatic generation button.
Refer. setting	×	○	Select the reference axis for the output angle.
Measurement	×	○	With security level 1 or higher, set the judgement conditions or edge position measurement parameters in this screen.
Output parameter	×	○	Select output parameters to specify how to handle coordinates.
Judgement	○	×	With security level 0, set the judgement conditions in this screen.

2-6-2 Region Setting

Set the entire region to use in busbar alignment.
Reference: Region Setting in Focus Adjustment section (page 17)

2-6-3 Edge Region

Set the edge regions for calculating the center coordinates and slanting of the cell.



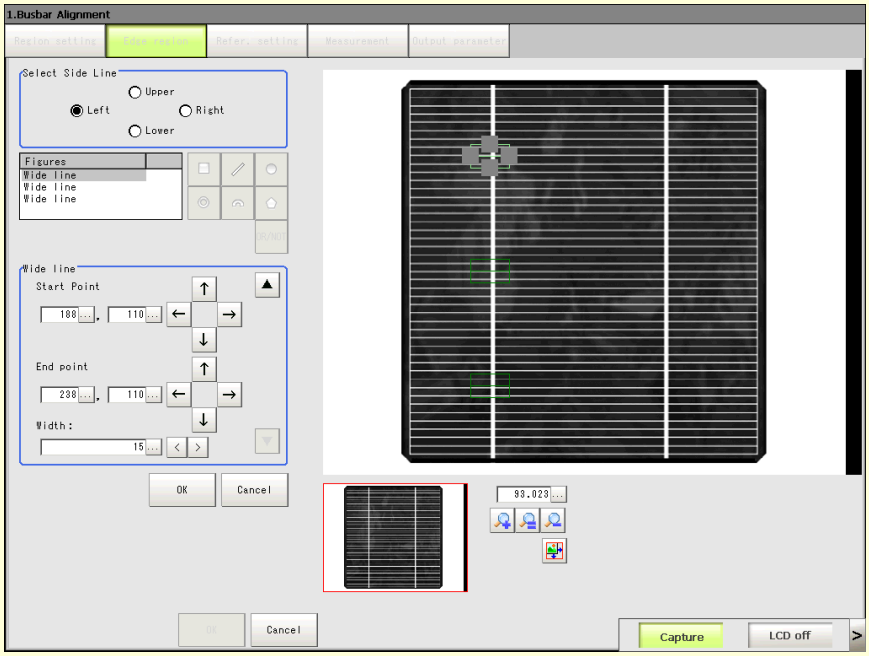
1. Set the measurement region.

Setting	Setting value [Factory default]	Description
Region setting	[Auto]	Set the edge regions automatically according to the settings in Binary setting and Detail setting of region.
	Manual	Set each edge position region manually.
Generation		Set according to the selected contents in Region setting. When set to Auto: Regions are set automatically. When set to Manual: The manual region setting screen is displayed.

Note When edge regions are set manually, set regions after setting the number of regions in Detail setting of region.

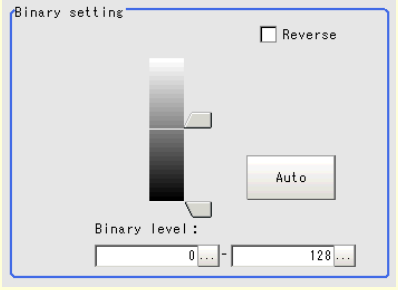
○When the [Generation] button is pressed with the Manual setting.

Select the side line to adjust with [Select Side Line]. The edge regions of the selected side line are displayed, so adjust the figure of the regions as required.



2. Adjust the binary level as required.

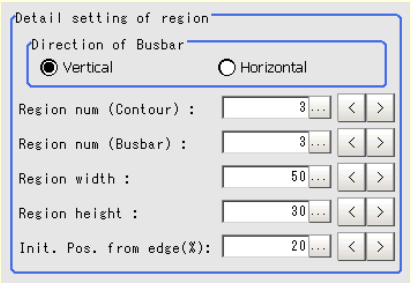
During automatic generation, use the binary image to extract the outline (side line), and generate an edge region on that side line.



Setting		Setting value [Factory default]	Description
Binary level	Lower limit value (Left)	0 to 255 [0]	Adjust the binary level so that the measurement object is converted to white pixels.
	Upper limit value (Right)	0 to 255 [128]	
Auto			Automatically optimize the binary level according to the image.
Reverse			Invert black and white in the binary image.

3. Adjust Detail setting of region as required.

The edge regions are set. Adjust the settings to make the size of automatically generated edge regions larger, etc.



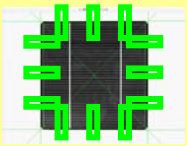
Setting	Setting value [Factory default]	Description
Direction of Busbar	[Vertical]	Select when the busbars are vertical.
	Horizontal	Select when the busbars are horizontal.
Region num (Contour)	2 to 5 [3]	Set the number of edge regions that will be generated on the cell contour.
Region num (Busbar)	2 to 5 [3]	Set the number of edge regions that will be generated on the cell busbars.
Region width	2 to 200 [50]	Specify the width (length) of the edge detection direction. (Unit: pixels)
Region height	1 to 200 [30]	Set the height (length) of the edge detection direction and vertical direction. (Unit: pixels)
Init. Pos. from edge	0 to 49 [20]	Use a percentage to specify the position at which an edge region will be generated based on the length of one side line of the cell outline. (Unit: %)

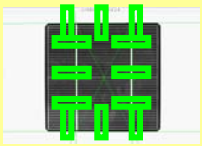
○When the [Generation] button is pressed with the Auto setting.

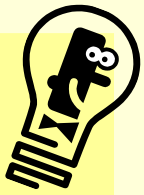
When the [Generation] is pressed with the Auto setting, edge regions will be automatically set in the same way as with contour alignment.

Reference: Contour Alignment Automatic Generation (page 24)

Quick Q&A







Q: What is the difference between contour alignment and busbar alignment?

A: The difference is that in contour alignment only the cell contour edge is used as a reference for measuring the center coordinates, while in busbar alignment the busbars are used as a reference in measuring the center coordinates. Another difference is that, in contour alignment, the cell upper side line direction and lower side line direction are used as reference for the output angle direction, while in busbar alignment the direction of the busbars is used as reference. Which method is more suitable depends on the inspection objective and the status of the cell image.

2-6-4 Refer. Setting (only for security level 1 or higher)

Match the calibration axes and output-angle on the display.

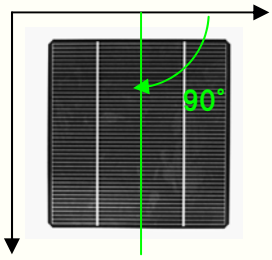
1. Select a reference axis as required.

Setting	Setting value [Factory default]	Description
Reference axis	[X-axis (0 degree)]	Output the angle as is without correcting it.
	Y-axis (-90 degree)	Output the angle after reducing it by 90 degrees.
	X-axis (+/-180 degree)	Output the angle after reducing it or increasing it by 180 degrees.
	Y-axis (+90 degree)	Output the angle after increasing it by 90 degrees.

Note

Adjust the reference axis in the following cases.

Robot coordinate system X

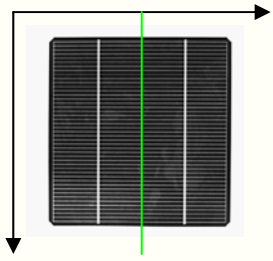


Robot coordinate system Y

In the case of a coordinate system like the one shown on the left, the line angle of the green line that indicates tilting of the cell is 90 degrees because it is perpendicular with the X axis, and it matches with what is seen on the display.*

In the case of this kind of coordinate system, select the default setting X-axis (0 degree).

Robot coordinate system Y



Robot coordinate system X

In the case of a coordinate system like the one shown on the left, the line angle of the green line that indicates tilting of the cell is 0 degrees in relation to the X axis, and it does not match with what is seen on the display. *

In the case of this kind of coordinate system, select Y-axis (+90 degree).

* If the cell is not tilted in the image

2-6-5 Measurement (only for security level 1 or higher)

Set the judgement conditions or edge position measurement parameters.

1. Set the judgement conditions.

Setting	Setting value [Factory default]	Description
Center position X	[-99999.9999 to 99999.9999]	Set the range to be judged as OK for the cell center position X.
Center position Y	[-99999.9999 to 99999.9999]	Set the range to be judged as OK for the cell center position Y.
Angle	[-180 to 180]	Set the range to be judged as OK for the cell angle.

2. Adjust the edge position measurement parameters.

> **Note** In detailed settings in Measurement, edge position is the same as with the standard FZ3 software.
>
> See the page listed below in the standard FZ3 software Processing Items List Manual.
>
> Processing Items List > Inspection and Measurement > Edge Position > Measurement (Edge Position)

2-6-6 Output Parameter (only for security level 1 or higher)

Select how to treat the values to be output to the external device as measurement results.

1. Select output parameters as required.

Setting	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	Select whether to output coordinate values before or after the position compensation is performed.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. - ON: Output the coordinate values converted into actual dimensions. - OFF: Output the camera coordinate values (Unit: pixels).
Reflect to overall judgement	[ON] OFF	Select whether to have the judgement result of the processing unit reflected in overall judgement.

> **Note** If Contour Alignment is registered with [Initialize Flow], calibration is automatically set to [ON].

2-6-7 Judgement (only for security level 0)

Set the judgement conditions.

1. Set the judgement conditions.

Setting	Setting value [Factory default]	Description
Center position X	[-99999.9999 to 99999.9999]	Set the range to be judged as OK for the cell center position X.
Center position Y	[-99999.9999 to 99999.9999]	Set the range to be judged as OK for the cell center position Y.
Angle	[-180 to 180]	Set the range to be judged as OK for the cell angle.

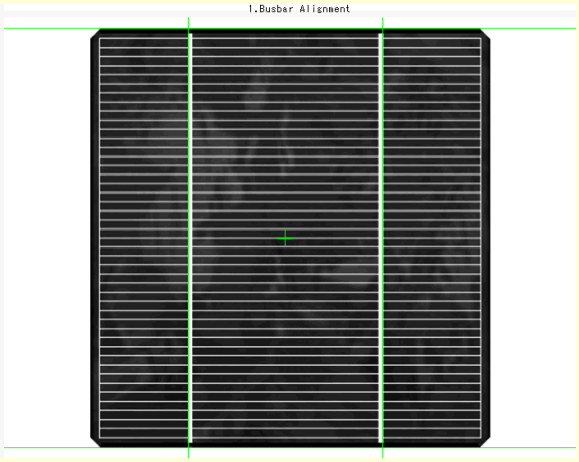
2-6-8 Display the Measurement Results

This section explains the contents of the Busbar Alignment measurements results display shown in the RUN mode screen and ADJUST mode screen.

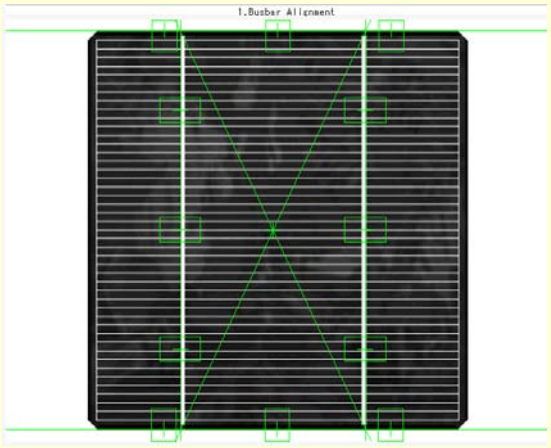
2-6-8-1 Image Display

Depending on the sub image number, the following kind of display will be seen.

Sub image No.: Image 0



Sub image No.: Image 1

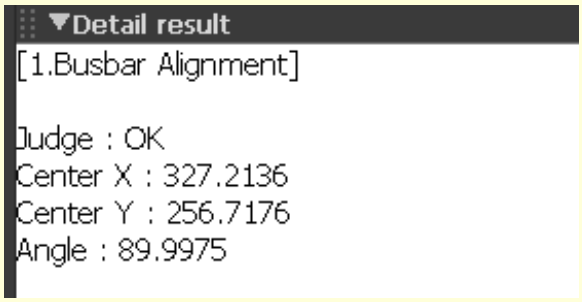


(○: Displays, X: Does not display)

Display item	Type	Sub image No.		Position list display	Description
		0	1		
Center position	Crosshair cursor	○	○	○	Displays the cell center position.
Approximated line	Line	○	○	○	Displays the approximated line for each side line.
Edge position	Crosshair cursor	×	○	×	Displays the edge positions of the edge regions on each side line.
Edge region	Wide line	×	○	×	Displays the edge regions on each side line.
Diagonal line	Line	×	○	×	Displays the diagonal lines of the circumscribed rectangle calculated from the intersections of the approximated lines for each side line.

2-6-8-2 Display the Detailed Results

The display the detailed results for busbar alignment will be display as shown below.



Display item	Display range	Description
Judge	OK/NG/Not yet measured	Displays the unit judgement result.
Center X	-99999.9999 to 99999.9999	Displays the X coordinate for the cell center position.
Center Y	-99999.9999 to 99999.9999	Displays the Y coordinate for the cell center position.
Angle	-180 to 180	Displays the cell angle.

2-6-9 Environment Setting (External Refference Tables)

The following values can be output using processing items related to results output. It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Output range	Description
Judgement	JG	1, 0, -1	Unit judgement result. 1: OK -1: NG 0: Not yet measured
Center position X	X	-99999.9999 to 99999.9999	X coordinate of the measured cell center position.
Center position Y	Y	-99999.9999 to 99999.9999	Y coordinate of the measured cell center position.
Angle	TH	-180 to 180	Cell tilting angle.
X coordinate after rotation correction	RX	-99999.9999 to 99999.9999	X coordinate after rotation correction by “angle” amount in X-Y-Theta stage.
Y coordinate after rotation correction	RY	-99999.9999 to 99999.9999	Y coordinate after rotation correction by “angle” amount in X-Y-Theta stage.
Upper left X coordinate of 4 cell vertices	C1X	-99999.9999 to 99999.9999	Upper left X coordinate of the measured cell circumscribed rectangle.
Upper left Y coordinate of 4 cell vertices	C1Y	-99999.9999 to 99999.9999	Upper left Y coordinate of the measured cell circumscribed rectangle.
Lower left X coordinate of 4 cell vertices	C2X	-99999.9999 to 99999.9999	Lower left X coordinate of the measured cell circumscribed rectangle.
Lower left Y coordinate of 4 cell vertices	C2Y	-99999.9999 to 99999.9999	Lower left Y coordinate of the measured cell circumscribed rectangle.
Upper right X coordinate of 4 cell vertices	C3X	-99999.9999 to 99999.9999	Upper right X coordinate of the measured cell circumscribed rectangle.
Upper right Y coordinate of 4 cell vertices	C3Y	-99999.9999 to 99999.9999	Upper right Y coordinate of the measured cell circumscribed rectangle.
Lower right X coordinate of 4 cell vertices	C4X	-99999.9999 to 99999.9999	Lower right X coordinate of the measured cell circumscribed rectangle.
Lower right Y coordinate of 4 cell vertices	C4Y	-99999.9999 to 99999.9999	Lower right Y coordinate of the measured cell circumscribed rectangle.

◎External Reference Table

No.	Data name	Get/Set	Range
0	Judgement	Get only	1：OK -1：NG 0：Not yet measured
5	Center position X	Get only	-99999.9999 to 99999.9999
6	Center position Y	Get only	-99999.9999 to 99999.9999
7	Angle	Get only	-180 to 180
8	X coordinate after rotation correction	Get only	-99999.9999 to 99999.9999
9	Y coordinate after rotation correction	Get only	-99999.9999 to 99999.9999
10	Upper left X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
11	Upper left Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
12	Lower left X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
13	Lower left Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
14	Upper right X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
15	Upper right Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
16	Lower right X coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
17	Lower right Y coordinate of 4 cell vertices	Get only	-99999.9999 to 99999.9999
101	Output coordinates	Get/Set	0：After scroll 1：Before scroll
102	Calibration	Get/Set	0：Calibration OFF 1：Calibration ON
103	Reflect to overall judgement	Get/Set	0：ON 1：OFF
121	Binary level upper limit value	Get/Set	0 to 255
122	Binary level lower limit value	Get/Set	0 to 255
123	Reverse	Get/Set	0: OFF 1: ON
124	Edge region width	Get only	2 to 200
125	Edge region height	Get only	1 to 200

No.	Data name	Get/Set	Range
128	Measurement region generation position	Get only	0 to 49
129	Center position X judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
130	Center position X judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
131	Center position Y judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
132	Center position Y judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
133	Angle judgement upper limit value	Get/Set	-180 to 180
134	Angle judgement lower limit value	Get/Set	-180 to 180
136	Number of edge regions (Contour)	Get only	2 to 5
137	Number of edge regions (Busbar)	Get only	2 to 5
140	Direction of Busbar	Get only	0: Vertical 1: Horizontal

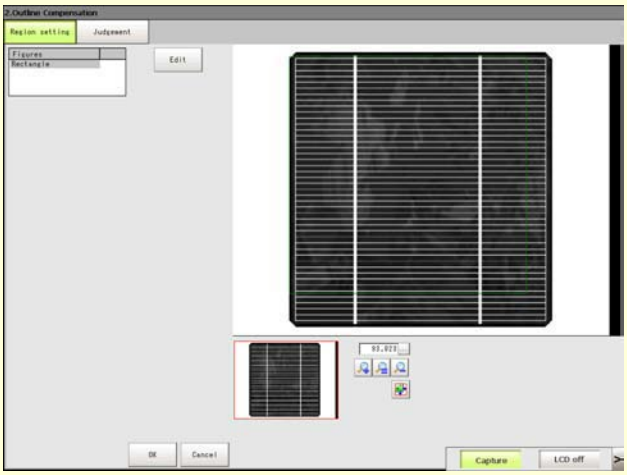
2-7 Outline Compensation

Automatically extracts the cell outline and then, while tracing the extracted outline points, detects locations where the perimeter and shape differ with the outline.

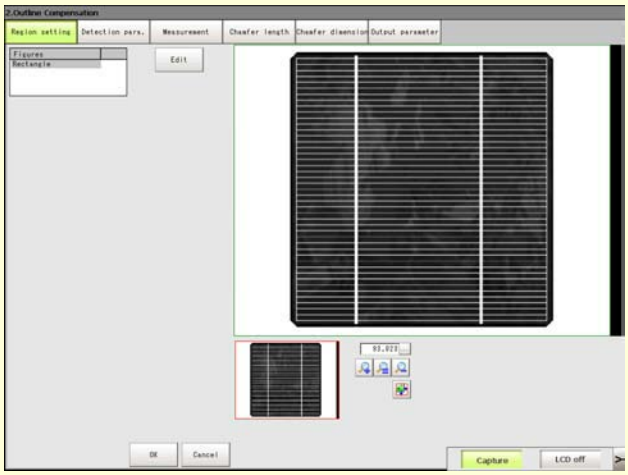
2-7-1 Menu Structure

The tabs displayed (parameters that can be set) will vary depending on the security level.

Security level 0



Security level 1 or higher



(○: Can be set, X: Cannot be set)

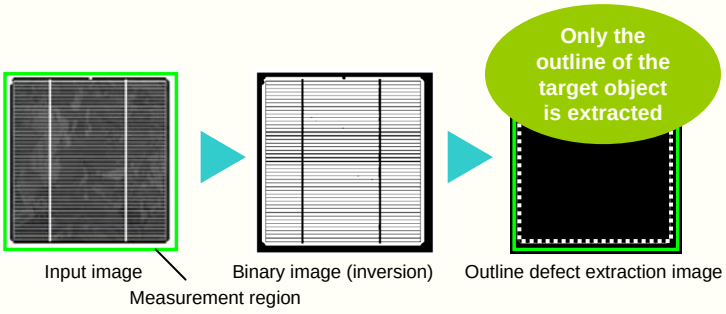
Tabs where setting is possible	Security level		Description
	Level 0	Level 1 or higher	
Region setting	○	○	Set the measurement regions for outline compensation.
Detection para.	×	○	Adjust the binary level for extract the contour or set the conditions for defect detection targets. Also, set the judgment conditions for the number of defects.
Measurement	×	○	Set the sort type for detected defects or set the edge measurement parameters for inspecting for defect depth. Also, set the judgment conditions for defect depth, etc.
Chamfer length	×	○	Set the cell corner conditions for chamfer length inspection. Also, set the judgement conditions for chamfer length inspection.
Chamfer dimension	×	○	Set the inspection conditions for chamfer dimension inspection. Also, set the judgement conditions for chamfer dimensions.
Output parameter	×	○	Select output parameters to specify how to handle coordinates.
Judgement	○	×	With security level 0, set all judgment conditions in this screen.

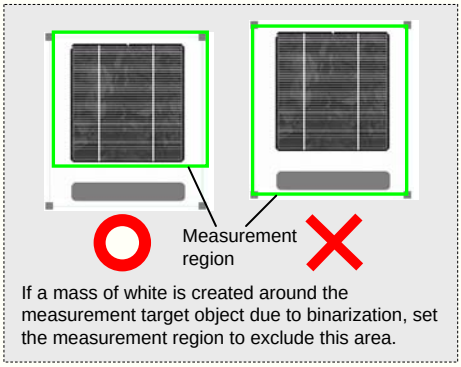
2-7-2 Region Setting

Set the measurement region for performing outline compensation.
Reference: Region Setting in Focus Adjustment section (page 18)

Important

With outline compensation, white pixels after binary processing are the measurement target for extracting the outline.
Set regions so that they exclude white pixels other than those of the measurement target object.


Only the outline of the target object is extracted
Input image
Measurement region
Binary image (inversion)
Outline defect extraction image


Measurement region
If a mass of white is created around the measurement target object due to binarization, set the measurement region to exclude this area.

2-7-3 Detection Para. (only for security level 1 or higher)

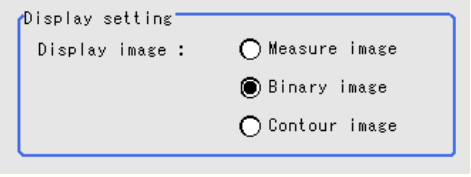
Adjust the binary level for extract the contour or set the conditions for defect detection targets. Also, set the judgment conditions for the number of defects.

1. Adjust the binary level.
Set so that the measurement target will be white. Binarization makes inspection of the outline and surrounding area possible.

Setting		Setting value [Factory default]	Description
Binary level	Lower limit value (Left)	0 to 255 [0]	Adjust the binary level.
	Upper limit value (Right)	0 to 255 [128]	
Auto			Automatically optimize the binary level according to the image.
Binary inversion			Invert black and white in the binary image.

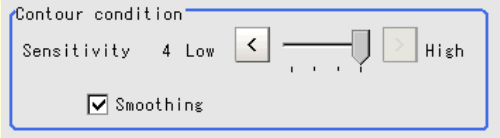
Note

To check the binary image, select Binary image in the bottom right of the Detection para. screen.



2. Set the Contour condition settings.

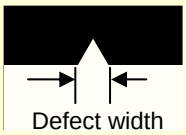
Change the degree of sensitivity when extracting the outline. Adjust as necessary.



Setting	Setting value [Factory default]	Description
Sensitivity	1 to 4 [4]	The higher the value, the easier it is to detect fine changes in the outline (=defects). However, this can also cause inspection to become unreliable in some cases due to background noise, etc.
Smoothing	[Checked]	Smoothing is performed before extract the contour. This helps lessen the effect of background noise and makes inspection reliable. In most cases, check this option.
	Unchecked	Smoothing is not performed before extract the contour. There is less resistance to background noise, but sensitivity in relation to fine defects is better.

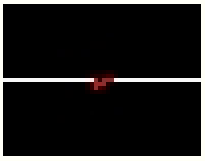
3. Set the detection conditions.

Adjust the width of defects to be detected or the defect detection level.

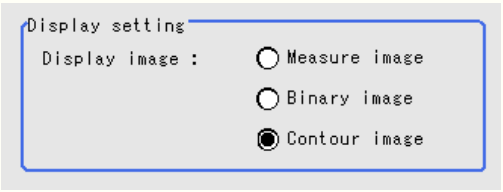
Setting	Setting value [Factory default]	Description
Defect detection width	1 to 1000 [30]	Set the standard for the defect width to be detected.Adjust to the desired defect size for detection.(Unit: pixels)  Defect width
Defect detection level	0 to 180 [10]	Detect defects at or above the defect detection level. The defect level numerically expresses the degree of change in comparison with an outline point on the perimeter. This can also be referred to as the sharpness of a defect. Defect level is high Defect level is low

Note

To check defects detected through contour conditions or detection conditions, select Contour image in the bottom right of the Detection para. screen.
The outline is displayed in white and the locations judged to be defects are displayed in red.



Contour image



3. Tap [Measure].

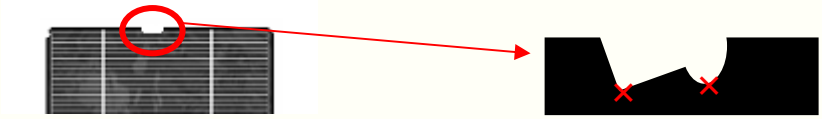
The number of defects with the current settings or contour images can be checked.

4. Set the judgement conditions regarding the number of defects.

Setting	Setting value [Factory default]	Description
Number of defects	0 to 100 [0 to 0]	Set the range for the number of defects (number of detected defects) that will be judged as OK.

Note

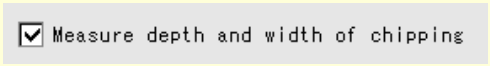
With the number of defects, even if a defect looks like a single defect, multiple defects will sometimes be detected in a single defect.



2-7-4 Measurement (only for security level 1 or higher)

Set the sort type for detected defects or set the edge measurement conditions for when defect depth, width, and position are measured. Also, set the judgement conditions for defect depth, width, and position. Adjust as necessary.

1. Select whether measurement inspection will be performed.

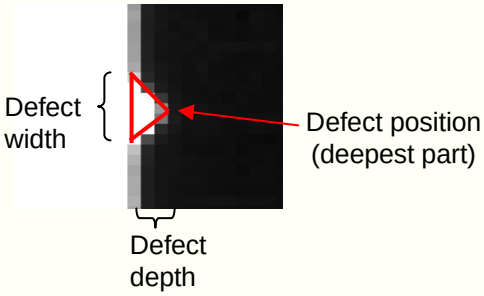


Setting	Setting value [Factory default]	Description
Measure depth and width of chipping	[Checked]	Measure depth, width, and position of detected defects.
	Unchecked	Do not measure depth, width, and position of detected defects. Select this when inspection is to be done only for the existence and number of defects.

Note

In measurement inspection, defect depth, defect width, and defect position (deepest part) can be measured.

In the Measurement screen, a triangular frame is displayed in the defect area as shown on the right. Enlarge the display to check the defect.



2. Set the measurement conditions.

Select the sort type when assigning numbers to detected defects or select the defect numbers that will be judgement targets.

Setting	Setting value [Factory default]	Description
Sort type	Depth ascending [Depth descending] Width ascending Width descending X ascending X descending Y ascending Y descending	Select the method for assigning numbers to detected defects. Ascending: Numbers are assigned in order from smaller values to larger. Descending: Numbers are assigned in order from larger values to smaller.
Defect number	0 to 100 [0]	Select the defect numbers that will be judgement targets for defect depth, width, and position measurement.

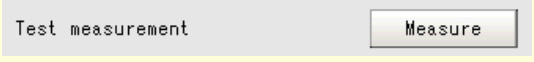
3. Set defect width and depth edge measurement.

Defect width, depth, and position is measured by additionally performing edge measurement for detected defects.

Setting	Setting value [Factory default]	Description
Density change	[Light→Dark]	Measure edges that move from light to dark. With this software, it is assumed that edges that move from the background (light) to the cell (dark) are measured, so select this option in most cases.
	Dark→Light	Measure edges that move from dark to light.
Edge level	0 to 100 [50]	Set the density change level that will be considered an edge.(Unit: %)
Noise level	0 to 255 [30]	If the density change is equal to or higher than this value, the location is considered to be an edge. When edges are incorrectly detected due to noise, increase this value.
Noise width	0 to 640 [5]	If the edge has a width smaller than this value, the location is considered noise.(Unit: pixels)
Region width	0 to 10 [0]	Set the width of the edge measurement region.Normally, setting this value at 0 is not a problem. However, if it is believed that the defect width or depth is not being accurately measured due to the effect of noise, increase this value.

4. Tap [Measure].

The defect depth, width, and positions with the current settings can be checked.

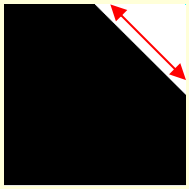


5. Set the judgement conditions for defect depth, width, and position.

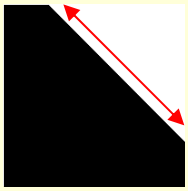
Setting	Setting value [Factory default]	Description
Defect depth	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set a defect depth range to be judged as OK.
Defect width	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set a defect width range to be judged as OK.
Defect position X	[-99999.9999 to 99999.9999]	Set a defect position X to be judged as OK.
Defect position Y	[-99999.9999 to 99999.9999]	Set a defect position Y to be judged as OK.

2-7-5 Chamfer Length Inspection (only for security level 1 or higher)

With outline compensation, the basic aim is detection of locations that are indented in relation to the perimeter edge. For this reason, detection can be difficult in the case shown below at the chamfer of a cell corner area where there is no indentation.
In chamfer length inspection, chamfer defects are detected by measuring the width of the corner.



Corner of acceptable cell



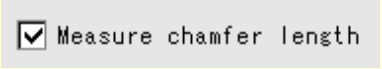
Chamfered corner of unacceptable cell

Measure the width of the corner (red arrow).

Important

Chamfer length inspection can only be performed if no defects have been found in outline tracing processing (if the number of defects is 0). If the number of defects is 1 or higher, chamfer length inspection will not be performed. The corner width and width difference will be 0 and the judgment result for chamfer length inspection will be an OK judgement.

1. Select whether chamfer length inspection will be performed.

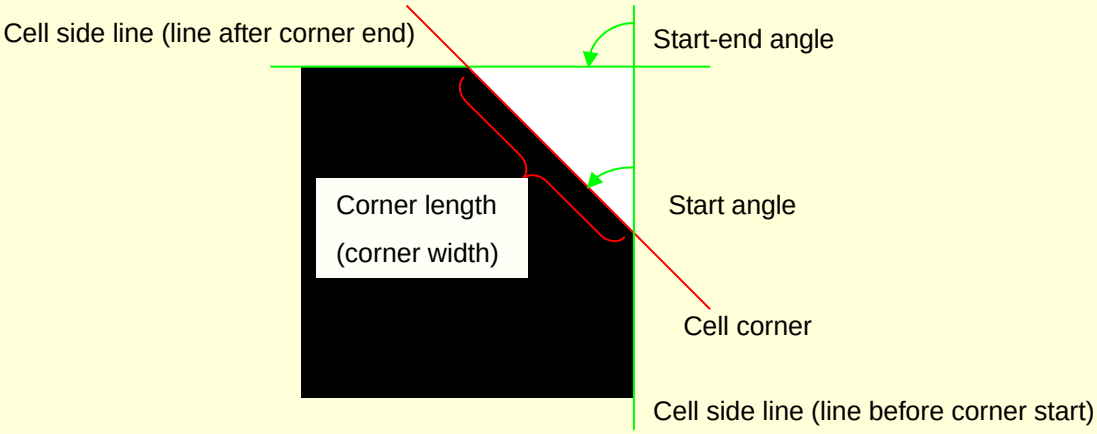


Setting	Setting value [Factory default]	Description
Measure chamfer length	Checked	Chamfer length inspection will be performed.
	[Unchecked]	Chamfer length inspection will not be performed.

2. Set the inspection conditions for chamfer length inspection.

Set the angle conditions and corner width conditions for judging the existence of a corner.

Setting	Setting value [Factory default]	Description
Corner judgement (start angle)	0 to 30 [15]	Set the angle standard for when the corner is reached along the cell side line. The point on the cell side line where the angle change is equal to or higher than the start angle is judged to be the corner start point. Set this value slightly lower than the actual angle. However, judgement may become unreliable if the value is set too low. (Unit: degrees)
Corner length	0 to 9999 [100]	Set the standard for the corner length. Side lines that are equal to or less than this value are judged as corners. Set this value slightly higher than the actual corner. (Unit: pixels)
Corner judgement (start–end angle)	0 to 120 [85]	Set the angle standard for the area from one cell side line (start) to the other cell side line (end). The point on the cell side line where the angle change is equal to or higher than the (start-end angle) is judged to be the corner end point. Set this value slightly lower than the actual angle. (Unit: degrees)



3. Press the [Measure] button.

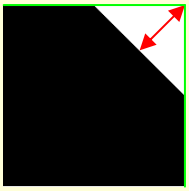
The corner width and corner width difference with the current settings can be checked. The center point of the corner start point and end point where the corner width is at a maximum is displayed in this image with a crosshair cursor.

4. Set the judgement conditions for chamfer length.

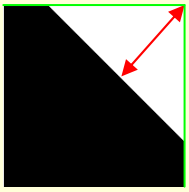
Setting	Setting value [Factory default]	Description
Corner width	[0.0000 to 99999.9999]	Set the corner width range to be judged as OK.
Corner width difference	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set the corner width difference range to be judged as OK. The corner width difference is the difference between the maximum width and minimum width among the widths of the 4 corners.

2-7-6 Chamfer Dimension Inspection (only for security level 1 or higher)

In chamfer dimension inspection, chamfer defects are detected by measuring the distance from the vertex of the cell circumscribed rectangle to the corner.



Corner of acceptable cell



Chamfered corner of unacceptable cell

Measure the depth of the corner (red arrow).

1. Select whether chamfer dimension inspection will be performed.

Setting	Setting value [Factory default]	Description
Measure chamfer dimension	Checked	Chamfer dimension inspection will be performed.
	[Unchecked]	Chamfer dimension inspection will not be performed.

2. Select the alignment unit.

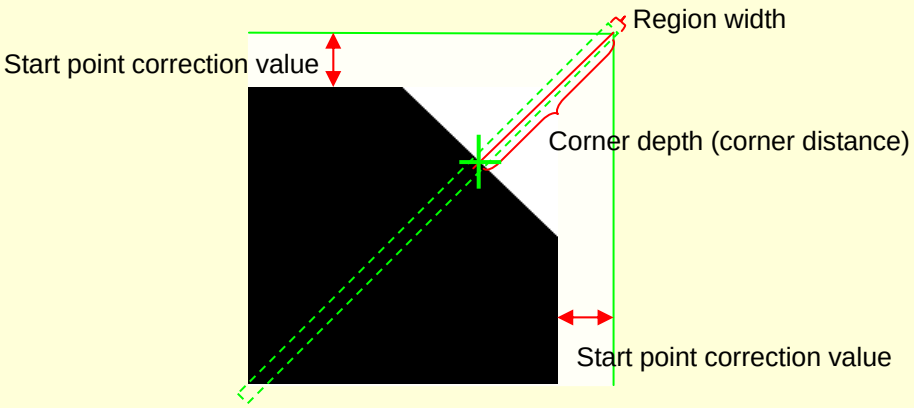
In chamfer dimension inspection, a cell circumscribed rectangle is calculated. If the contour alignment unit is in the flow, it is possible to improve the accuracy of the circumscribed rectangle and shorten the processing time by using the measurement data from the unit.

Setting	Setting value [Factory default]	Description
Target unit	– [OFF]	Select the target unit from contour alignment set in the flow. If contour alignment does not exist in the flow, this is set at [OFF].

3. Set the inspection conditions for chamfer dimension.

In chamfer dimension inspection, edge measurement is performed moving from the cell circumscribed rectangle toward the cell center and the distance from the vertex to the corner edge is calculated. Correct the position of the vertex or adjust the edge measurement region.

Setting	Setting value [Factory default]	Description
Start point correction value	0 to 10 [5]	Makes the start point a vertex of a rectangle that is larger than the calculated circumscribed rectangle by the correction amount.Adjust this setting if the accuracy of the calculated circumscribed rectangle is poor and chamfer dimension inspection is not reliable.(Unit: pixels)
Region width	0 to 100 [5]	Set the width of the edge measurement region.(Unit: pixels)



Note

Except for region width in chamfer dimension inspection, edge measurement parameters such as edge level or noise level depend on the “defect width and depth edge measurement” settings in the Measurement screen.(Page 50)

4. Tap [Measure].

The corner distance and corner distance difference with the current settings can be checked.The circumscribed rectangle and the lines from the vertices of the rectangle to the corners are displayed.

5. Set the inspection conditions for chamfer dimension.

Setting	Setting value [Factory default]	Description
Corner distance	[0.0000 to 99999.9999]	Set the corner distance range to be judged as OK.
Corner distance difference	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set the corner distance difference range to be judged as OK. The corner distance difference is the difference between the maximum distance and minimum distance among the distances at the 4 corners.

2-7-7 Output Parameter (only for security level 1 or higher)

In the Output parameter screen, select how to treat the values to be output to the external device as measurement results.

1. Select output parameters as required.

Setting	Setting value [Factory default]	Description
Output coordinates	[After scroll] Before scroll	Select whether to output coordinate values before or after the position compensation is performed.
Calibration	[OFF] ON	Select whether to reflect the calibration in the values output to the external device as measurement results. - ON: Output the coordinate values converted into actual dimensions. - OFF: Output the camera coordinate values (Unit: pixels).
Reflect to overall judgement	[ON] OFF	Select whether to have the judgement result of the processing unit reflected in overall judgement.

2-7-8 Judgement (only for security level 0)

Set the judgement conditions in the Judgement screen.

1. Set the judgement conditions.

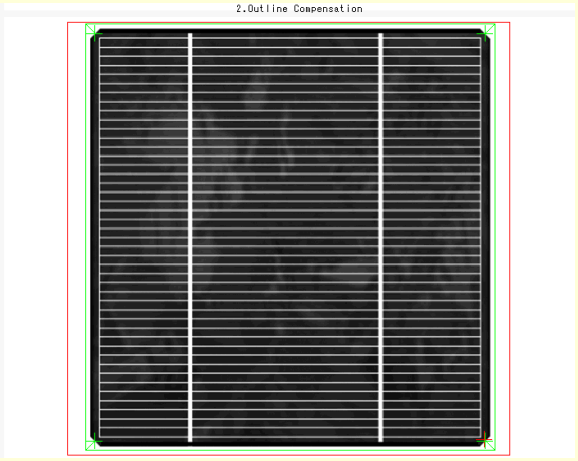
Setting	Setting value [Factory default]	Description
Number of defects	0 to 100 [0 to 0]	Set the range for the number of defects (number of detected defects) that will be judged as OK.
Defect depth	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set a defect depth range to be judged as OK.
Defect width	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set a defect width range to be judged as OK.
Defect position X	[-99999.9999 to 99999.9999]	Set a defect position X to be judged as OK.
Defect position Y	[-99999.9999 to 99999.9999]	Set a defect position Y to be judged as OK.
Corner width	[0.0000 to 99999.9999]	Set the corner width range to be judged as OK.
Corner width difference	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set the corner width difference range to be judged as OK. The corner width difference is the difference between the maximum width and minimum width among the widths of the 4 corners.
Corner distance	[0.0000 to 99999.9999]	Set the corner distance range to be judged as OK.
Corner distance difference	0.0000 to 99999.9999 [0.0000 to 1.0000]	Set the corner distance difference range to be judged as OK. The corner distance difference is the difference between the maximum distance and minimum distance among the distances at the 4 corners.

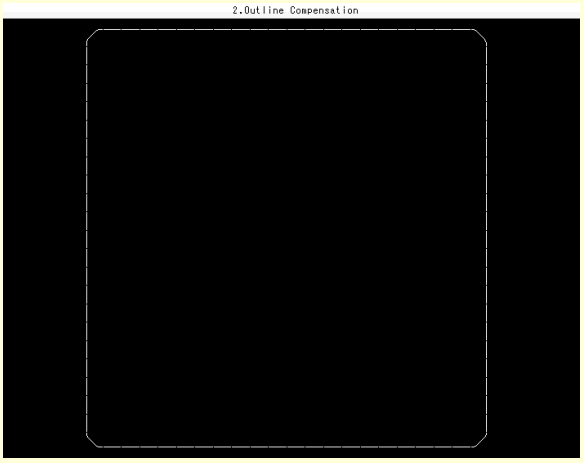
2-7-9 Display the Measurement Results

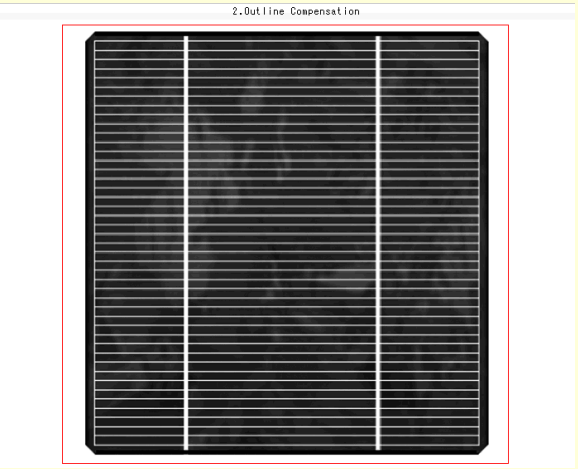
This section explains the contents of the Outline Compensation measurements results display shown in the RUN mode screen and ADJUST mode screen.

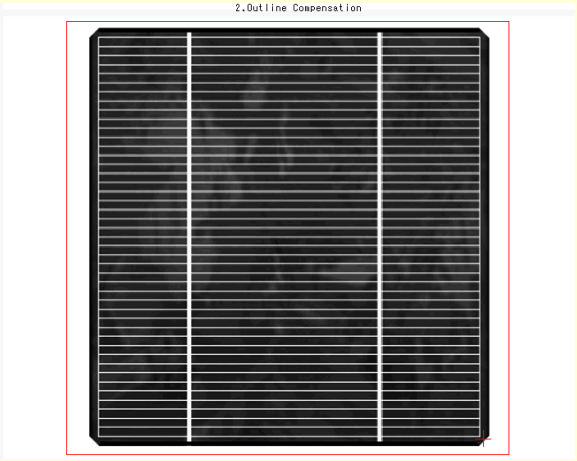
2-7-9-1 Image Display

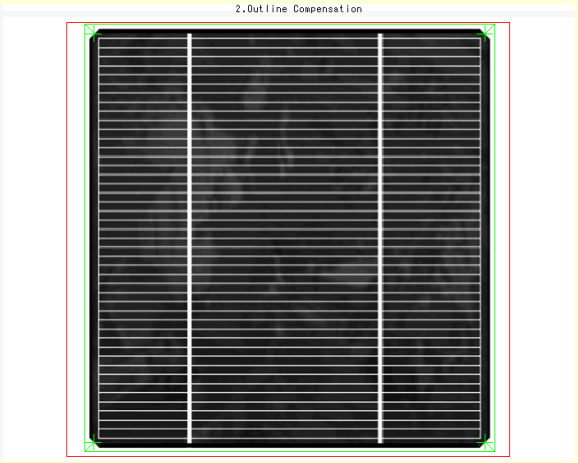
Depending on the sub image number, the following kind of display will be seen.











The listed images are shown in sequence from the top left.

Sub image No.: Image 0, Sub image No.: Image 1

Sub image No.: Image 2, Sub image No.: Image 3

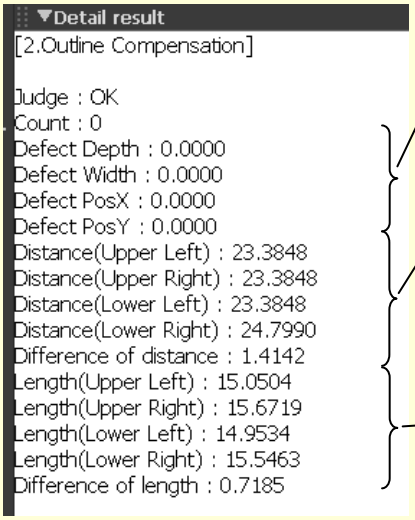
Sub image No.: Image 4

(○: Displays, X: Does not display)

Display item	Type	Sub image No.					Posi-tion list	Description
		0	1	2	3	4		
Measurement region	Rectangle	○	×	○	○	○	×	Displays the measurement region of the unit. The display is green if judgement is OK, and red if the judgement is NG.
Defect position	Crosshair cursor	○	×	×	×	×	○	Displays detected defect positions in red. There is no display if there are no defects.
Outline image	Outline image	×	○	×	×	×	×	Displays the extracted outline image in white. Defect areas display in red.
Defect width and depth	Triangle	×	×	○	×	×	×	Displays a triangle connecting the defect width with the deepest area of the defect. The display is green if the defect width and depth judgement is OK, and red if the judgement is NG. There is no display if measurement inspection is not performed.
Chamfer length position	Crosshair cursor	×	○	×	○	×	×	Displays in red the corner coordinates where chamfer length judgement became NG. There is no display if chamfer length inspection is not performed.
Chamfer dimension position	Crosshair cursor	×	○	×	×	○	×	Displays in red the corner coordinates where chamfer dimension judgement became NG. There is no display if chamfer dimension inspection is not performed.
Chamfer dimension line	Line/ Rectangle	×	×	×	×	○	×	Displays a circumscribed rectangle and a line from the vertex to the corner from chamfer dimension inspection.

2-7-9-2 Display the Detailed Results

The display the detailed results for outline compensation will be displayed as shown below. The display contents change depending on the inspection settings.



There is no display if measurement inspection (defect width and depth) is not performed.

There is no display if chamfer length inspection is not performed. Also, if the number of defects is 1 or higher, chamfer length inspection will not be performed. For this reason, the values will be 0 regardless of the chamber length judgment conditions and these items will be displayed in gray indicating that they have not yet been measured.

There is no display when chamfer dimension inspection is set not to be performed.

Display item	Display range	Description
Judge	OK/NG/Not yet measured	Displays the unit judgement result.
Count	0 to 100	Displays the number of defects detected.
Defect Depth	0.0000 to 99999.9999	Displays defect depth. Only displays if measurement inspection is performed.
Defect Width	0.0000 to 99999.9999	Displays defect width. Only displays if measurement inspection is performed.
Defect PosX	-99999.9999 to 99999.9999	Displays the X coordinate of detected defects. Only displays if measurement inspection is performed.
Defect PosY	-99999.9999 to 99999.9999	Displays the Y coordinate of detected defects. Only displays if measurement inspection is performed.
Distance (Upper Left)	0.0000 to 99999.9999	Displays the upper left corner width. Only displays if chamfer length inspection is performed.
Distance (Upper Right)	0.0000 to 99999.9999	Displays the upper right corner width. Only displays if chamfer length inspection is performed.
Distance (Lower Left)	0.0000 to 99999.9999	Displays the lower left corner width. Only displays if chamfer length inspection is performed.
Distance (Lower Right)	0.0000 to 99999.9999	Displays the lower right corner width. Only displays if chamfer length inspection is performed.
Difference of distance	0.0000 to 99999.9999	Displays the corner difference among the 4 corners. Only displays if chamfer length inspection is performed.
Length (Upper Left)	0.0000 to 99999.9999	Displays the upper left corner distance. Only displays if chamfer dimension inspection is performed.
Length (Upper Right)	0.0000 to 99999.9999	Displays the upper right corner distance. Only displays if chamfer dimension inspection is performed.
Length (Lower Left)	0.0000 to 99999.9999	Displays the lower left corner distance. Only displays if chamfer dimension inspection is performed.
Length (Lower Right)	0.0000 to 99999.9999	Displays the lower right corner distance. Only displays if chamfer dimension inspection is performed.
Difference of length	0.0000 to 99999.9999	Displays the distance difference among the 4 corners. Only displays if chamfer dimension inspection is performed.

Note In the display the detailed results, for each measurement value judgment, the value displays in black if the judgement is OK and red if the judgment is NG.When measurement has not yet been performed, only Judge will display in gray and the other measurement values will not display.

2-7-10 Environment Setting (External Refference Tables)

The following values can be output using processing items related to results output.It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Output range	Description
Judgement	JG	1, 0, -1	Unit judgement result. 1: OK -1: NG 0: Not yet measured
Number of defects	CT	0 to 100	Number of defects detected.
Defect depth	DP	0.0000 to 99999.9999	Depth of defect specified with defect number.
Defect width	WD	0.0000 to 99999.9999	Width of defect specified with defect number.
Defect position X	DX	-99999.9999 to 99999.9999	X coordinate of defect specified with defect number.
Defect position Y	DY	-99999.9999 to 99999.9999	Y coordinate of defect specified with defect number.
Corner width (upper left)	CWD1	0.0000 to 99999.9999	Upper left corner width.
Corner width (upper right)	CWD2	0.0000 to 99999.9999	Upper right corner width.
Corner width (lower left)	CWD3	0.0000 to 99999.9999	Lower left corner width.
Corner width (lower right)	CWD4	0.0000 to 99999.9999	Lower right corner width.
Corner width distance	CWGP	0.0000 to 99999.9999	Width difference among the 4 corners.
Corner distance (upper left)	CDD1	0.0000 to 99999.9999	Upper left corner distance.
Corner distance (upper right)	CDD2	0.0000 to 99999.9999	Upper right corner distance.
Corner distance (lower left)	CDD3	0.0000 to 99999.9999	Lower left corner distance.
Corner distance (lower right)	CDD4	0.0000 to 99999.9999	Lower right corner distance.
Corner distance difference	CDGP	0.0000 to 99999.9999	Length difference among the 4 corners.
Defect depth 0	DP0	0.0000 to 99999.9999	Defect depth of defect No. 0.
Defect width 0	WD0	0.0000 to 99999.9999	Defect width of defect No. 0.
Defect position X0	DX0	-99999.9999 to 99999.9999	X coordinate of defect No. 0
Defect position Y0	DY0	-99999.9999 to 99999.9999	Y coordinate of defect No. 0
•••			
Defect depth 99	DP99	0.0000 to 99999.9999	Defect depth of defect No. 99.
Defect width 99	WD99	0.0000 to 99999.9999	Defect width of defect No. 99.
Defect position X99	DX99	-99999.9999 to 99999.9999	X coordinate of defect No. 99.
Defect position Y99	DY99	-99999.9999～99999.9999	Y coordinate of defect No. 99

◎External Reference Table

No.	Data name	Get/Set	Range
0	Judgement	Get only	1: OK -1: NG 0: Not yet measured
5	Number of defects	Get only	0 to 100
6	Defect depth	Get only	0.0000 to 99999.9999
7	Defect width	Get only	0.0000 to 99999.9999
8	Defect position X	Get only	-99999.9999 to 99999.9999
9	Defect position Y	Get only	-99999.9999 to 99999.9999
10	Corner width (upper left)	Get only	0.0000 to 99999.9999
11	Corner width (upper right)	Get only	0.0000 to 99999.9999
12	Corner width (lower left)	Get only	0.0000 to 99999.9999
13	Corner width (lower right)	Get only	0.0000 to 99999.9999
14	Corner width distance	Get only	0.0000 to 99999.9999
15	Corner distance (upper left)	Get only	0.0000 to 99999.9999
16	Corner distance (upper right)	Get only	0.0000 to 99999.9999
17	Corner distance (lower left)	Get only	0.0000 to 99999.9999
18	Corner distance (lower right)	Get only	0.0000 to 99999.9999
19	Corner distance difference	Get only	0.0000 to 99999.9999
101	Output coordinates	Get/Set	0: After scroll 1: Before scroll
102	Calibration	Get/Set	0: Calibration OFF 1: Calibration ON
103	Reflect to overall judgement	Get/Set	0: ON 1: OFF
120	Binary level upper limit value	Get/Set	0 to 255
121	Binary level lower limit value	Get/Set	0 to 255
122	Reverse	Get/Set	0: OFF 1: ON

No.	Data name	Get/Set	Range
124	Sensitivity	Get/Set	1 to 4
126	Defect detection width	Get/Set	0 to 1000
128	Sort type	Get/Set	0: Depth ascending 1: Depth descending 2: Width ascending 3: Width descending 4: X ascending 5: X descending 6: Y ascending 7: Y descending
129	Defect number	Get/Set	0 to 99
131	Number of defects judgement upper limit value	Get/Set	0 to 100
132	Number of defects judgement lower limit value	Get/Set	0 to 100
133	Defect detection level	Get/Set	0 to 180
135	Defect position X judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
136	Defect position X judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
137	Defect position Y judgement upper limit value	Get/Set	-99999.9999 to 99999.9999
138	Defect position Y judgement lower limit value	Get/Set	-99999.9999 to 99999.9999
139	Defect depth judgement upper limit value	Get/Set	0.0000 to 99999.9999
140	Defect depth judgement lower limit value	Get/Set	0.0000 to 99999.9999
141	Defect width judgement upper limit value	Get/Set	0.0000 to 99999.9999
142	Defect width judgement lower limit value	Get/Set	0.0000 to 99999.9999
146	Measurement inspection performance flag	Get/Set	0: OFF 1: ON
147	Chamfer dimension inspection performance flag	Get/Set	0: OFF 1: ON
148	Chamfer length inspection performance flag	Get/Set	0: OFF 1: ON
149	Alignment target unit No.	Get/Set	-1 to 9999 (-1: None)
150	Smoothing performance flag	Get/Set	0: OFF 1: ON
151	Edge level (defect width and depth edge measurement)	Get/Set	0 to 100
152	Noise level (defect width and depth edge measurement)	Get/Set	0 to 255

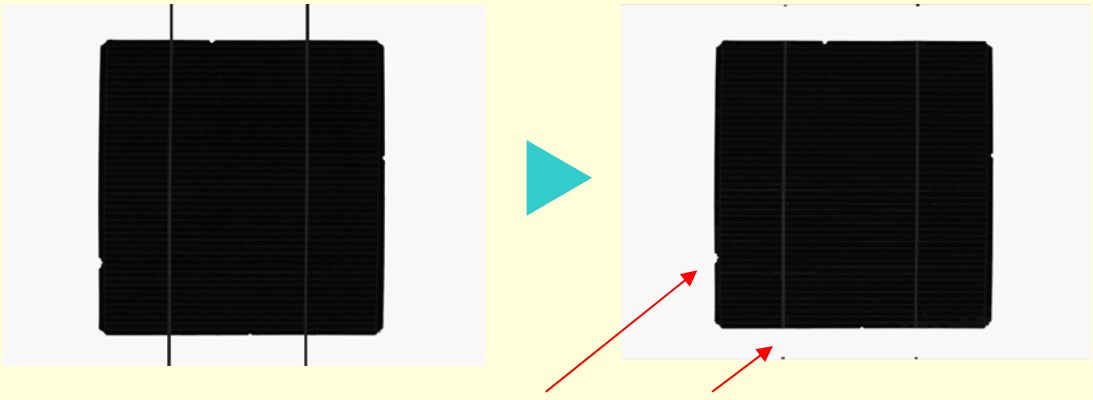
No.	Data name	Get/Set	Range
153	Region width (defect width and depth edge measurement)	Get only	0 to 10
154	Noise width (defect width and depth edge measurement)	Get/Set	0 to 640
155	Corner judgement (start angle)	Get/Set	0 to 30
156	Corner length	Get/Set	0 to 9999
157	Corner judgement (start–end angle)	Get/Set	0 to 120
158	Corner width judgement upper limit value	Get/Set	0.0000 to 99999.9999
159	Corner width judgement lower limit value	Get/Set	0.0000 to 99999.9999
160	Corner width difference judgement upper limit value	Get/Set	0.0000 to 99999.9999
161	Corner width difference judgement lower limit value	Get/Set	0.0000 to 99999.9999
162	Corner distance judgement upper limit value	Get/Set	0.0000 to 99999.9999
163	Corner distance judgement lower limit value	Get/Set	0.0000 to 99999.9999
164	Corner distance difference judgement upper limit value	Get/Set	0.0000 to 99999.9999
165	Corner distance difference judgement lower limit value	Get/Set	0.0000 to 99999.9999
166	Start point correction value	Get/Set	0 to 10
167	Region width (chamfer dimension inspection)	Get only	0 to 100
168	Density change (defect width and depth edge measurement)	Get/Set	0: Light→Dark 1: Dark→Light
1000 + N × 4 (N = 0 to 99)	Defect depth N	Get only	0.0000 to 99999.9999
1001 + N × 4 (N = 0 to 99)	Defect width N	Get only	0.0000 to 99999.9999
1002 + N × 4 (N = 0 to 99)	Defect position XN	Get only	-99999.9999 to 99999.9999
1003 + N × 4 (N = 0 to 99)	Defect position YN	Get only	-99999.9999 to 99999.9999

2-8 Tab Cancellation

Deletes tabs around the cell through image correction processing. Outline compensation after tab storing is possible even without using the region mask setting.

Before tab cancellation

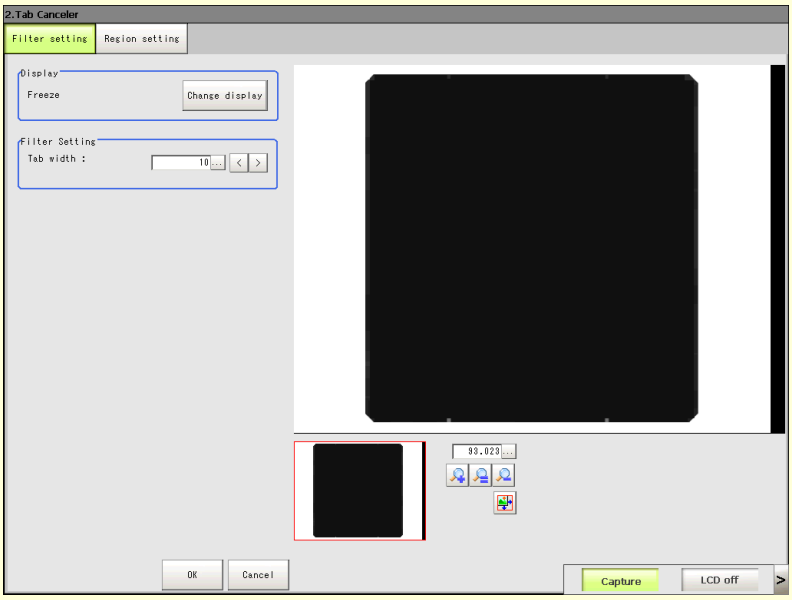
After tab cancellation



Only tabs are deleted. Defect areas are left as is. This makes it possible for outline compensation to be performed without being affected by the tab outlines.

2-8-1 Menu Structure

The Tab Canceler processing items are included in the setting contents for all users.



Tabs where setting is possible	Description
Filter setting	Adjust the tab width for cancelling tabs.
Region setting	Set the region for cancelling tabs.

2-8-2 Filter Setting

Adjust the tab width for cancelling tabs. Also, by using through display, adjustment can always be performed when an image is input from the camera.

1. Switch between Freeze and Through display as necessary.

In Freeze display, an image with tabs cancelled is displayed using the last image input from the camera. In Through display, images with the tabs cancelled are always displayed as images are input. The display changes to Freeze display when the settings screen is entered.

2. Adjust the tab width for cancelling tabs.

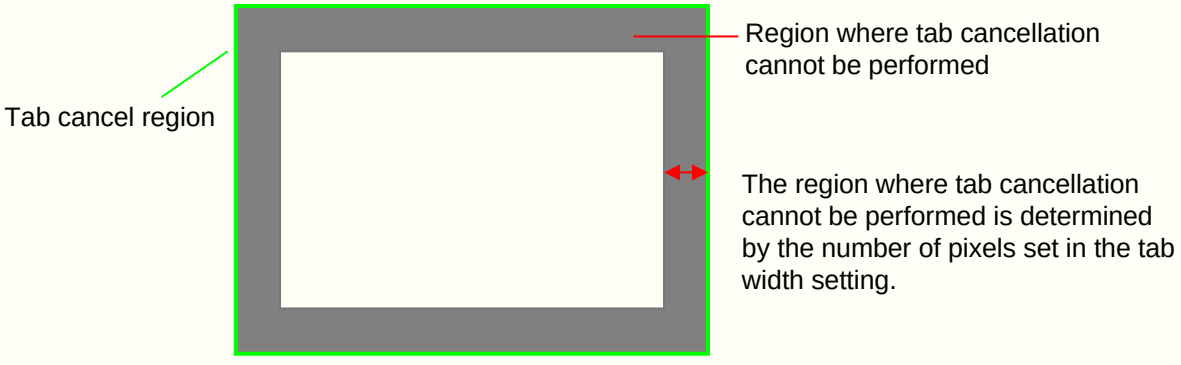
Setting	Setting value [Factory default]	Description
Tab width	0〜20 [10]	Increase the value in accordance with the tab size for cancellation. Adjust while checking the image. When 0 is specified, tab cancel processing is not performed.

Note Tab cancel is useable when tabs are dark in relation to the background. In contrast, it cannot be used if the tabs are bright in relation to the background. In this case, change the lighting conditions or other conditions.

2-8-3 Region Setting

Set the region to perform tab cancellation.
Reference: Region Setting in Focus Adjustment section (page 17)

Important Tab cancellation cannot be performed in the area around the frame of the tab cancel region. Set the tab cancel region so that there is some extra room. The range over which cancellation cannot be performed will vary according to the tab width setting.


Region where tab cancellation cannot be performed
Tab cancel region
The region where tab cancellation cannot be performed is determined by the number of pixels set in the tab width setting.

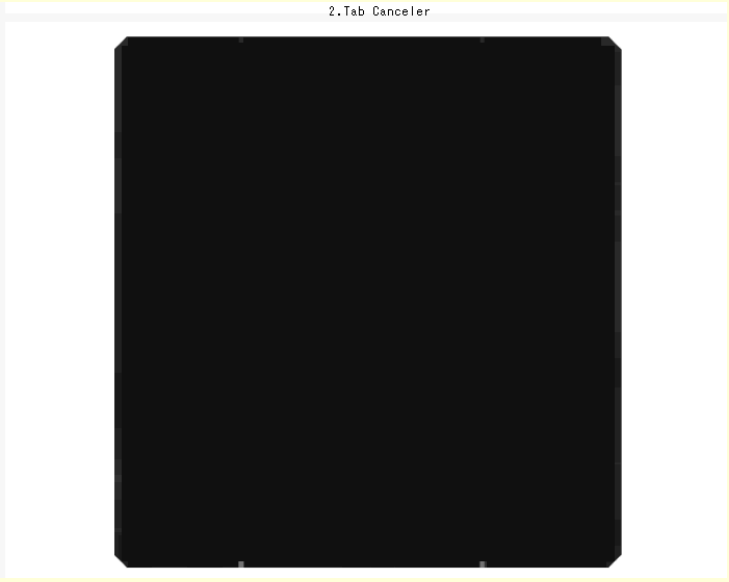
2-8-4 Display the Measurement Results

This section explains the contents of the Tab Canceler measurements results display shown in the RUN mode screen and ADJUST mode screen.

2-8-4-1 Image Display

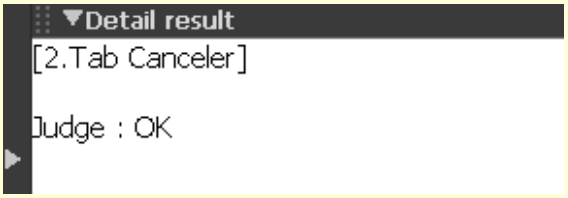
The image after tab cancellation is displayed regardless of the sub image numbers.

Image after tab cancellation



2-8-4-2 Display the Detailed Results

The display the detailed results for tab cancellation displays as shown below.



Display item	Display range	Description
Judge	OK/NG/Not yet measured	Displays the unit judgement result.

Note

Tab cancel is an image input processing item. If the limit on use of image input processing items has been reached, an NG judgement (lack of memory) may occur.

For limitations on the number of image input processing items used, see the page listed below in the standard FZ3 software User's Manual.

Environment Setting Part > Appendix > Limits on the Number of Image Input Processing Items Used

2-8-5 Environment Setting (External Refference Tables)

The following values can be output using processing items related to results output.It is also possible to reference measurement values from expressions and other processing units.

Data name	Character string	Output range	Description
Judgement	JG	1,0,-1	Unit judgement result. 1: OK -1: NG 0: Not yet measured

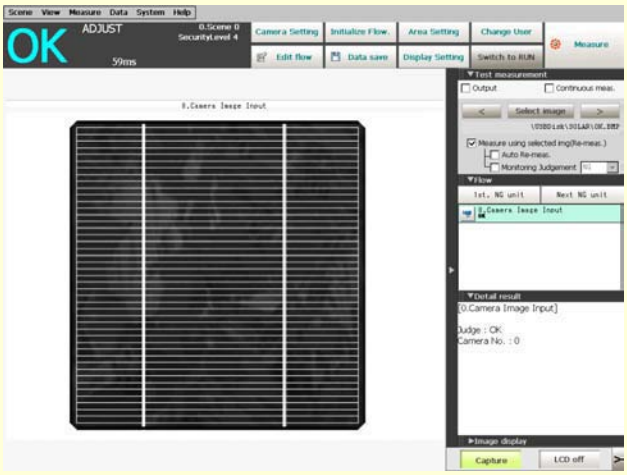
◎External Reference Table

No.	Data name	Get/Set	Range
0	Judgement	Get only	1: OK -1: NG 0: Not yet measured
122	Tab width	Get/Set	0 to 20

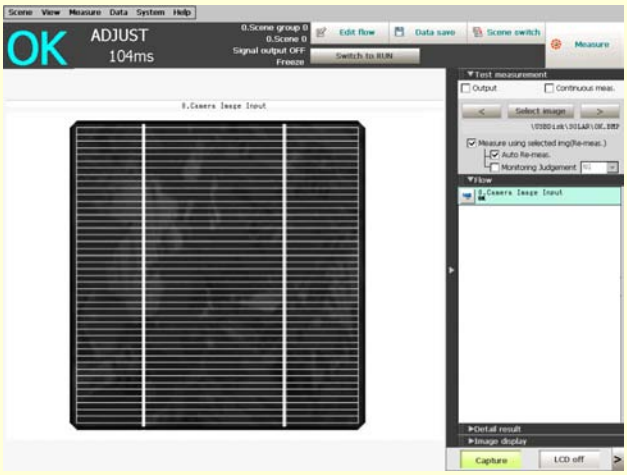
3-1 Select ADJUST Mode Screen

Whether to make the ADJUST mode screen the special screen from this software or the same screen as the standard FZ3 software can be selected.

Special Screen



Default Screen



1. Select [System] - [Controller] - [Select ADJUST mode] in the ADJUST mode screen.
Select the ADJUST mode screen to use.

Setting item	Setting value [Factory default]	Description
Select ADJUST mode screen	[Special screen]	This is the ADJUST mode screen for the PV cell defect inspection. Various specialized functions are collectively listed in the Main screen. (Page 5)
	Default screen	This is the same ADJUST mode screen as the standard FZ3 software. Use this screen in cases such as when getting used to standard FZ3 software operation.

Note For the contents of the FZ3 ADJUST mode screen, see the page listed below in the standard FZ3 software User's Manual.

Operation Part > Before Operation > Screens/Windows > Main Screen (ADJUST mode screen)

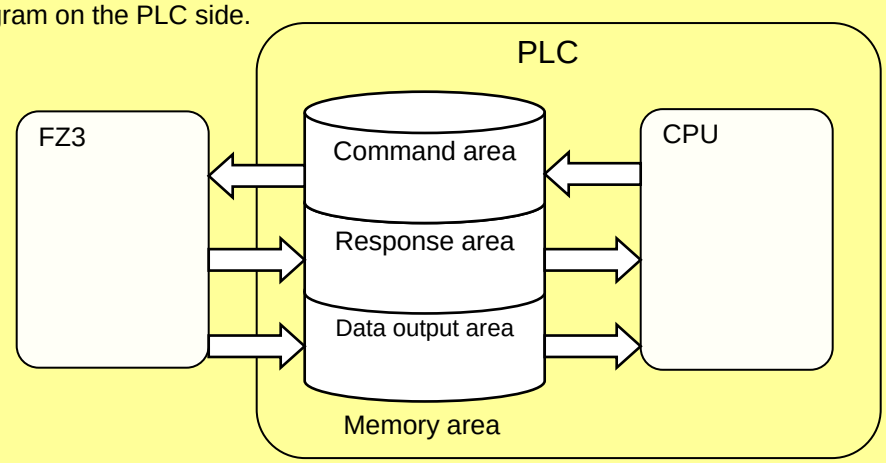
3-2 PLC Link Function for Communication with Mitsubishi PLC

In the standard FZ3 software, there is PLC link function included that allows for easy communication with OMRON PLCs.
In the software explained in this manual, in addition to OMRON PLCs, a PLC link function for communication with Mitsubishi PLCs is included.

Quick Q&A

Q: What is a PLC link function?

A: The FZ3 PLC link function is a function that performs communication using three link areas: the command area, response area, and data output area. This allows the PLC to perform communication control with the sensor side just through reading and writing of the allocated I/O memory area. This makes it possible to lessen the burden involved in creating the ladder program on the PLC side.



3-2-1 Limitations and Precautions of PLC Link with Mitsubishi PLC

Basic commands and the timing chart are the same as the PLC link function for communication with OMRON PLCs, but there are several restrictions.

[Compatible Mitsubishi PLCs and communication interfaces]

	Ethernet	RS-232C/422
Q series	○	×
A series	×	×

[Useable PLC memory area]

With Mitsubishi PLCs, only the “D” data register can be used.

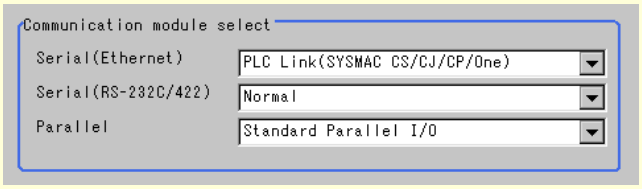
3-2-2 PLC Link Communication Settings Procedure

The setting procedure for PLC link communication settings on the FZ3 side is as follows.

1. Select [System] - [Controller] - [Startup setting] in the ADJUST mode screen.

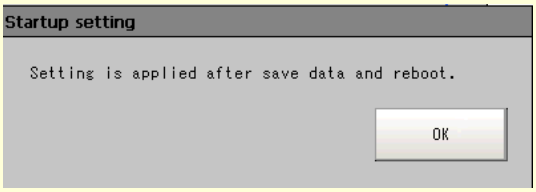
2. Set [PLC Link (SYSMAC CS/CJ/CP/One)] for Serial (Ethernet) in Communication module select.

* The Mitsubishi PLC format is not displayed. However, PLC linking with Mitsubishi PLCs is possible with this setting.



3. Pressing the [OK] button in Startup setting will display the message shown below. Press [OK].

The screen returns to the ADJUST mode screen.

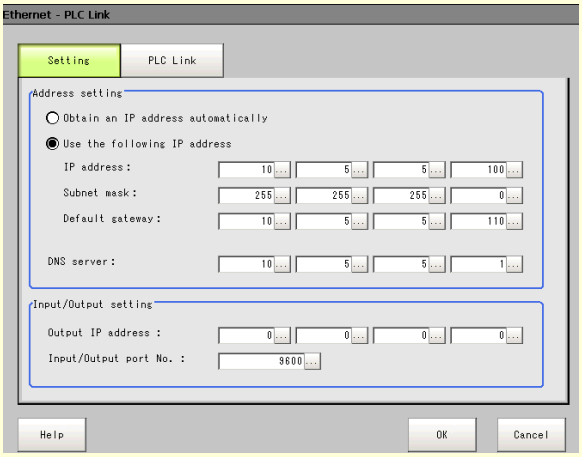


4. In the ADJUST mode screen, tap the [Data save] button.After saving data is completed, restart the FZ3.

Important After making changes in Startup setting, make sure to restart after using [Data save]. The changes will be reflected after restarting.

5. After restarting, select [System] - [Communication] - [Serial] – [Ethernet] – [Setting] in the ADJUST mode screen.

Set the FZ3 IP address and other settings for link areas.

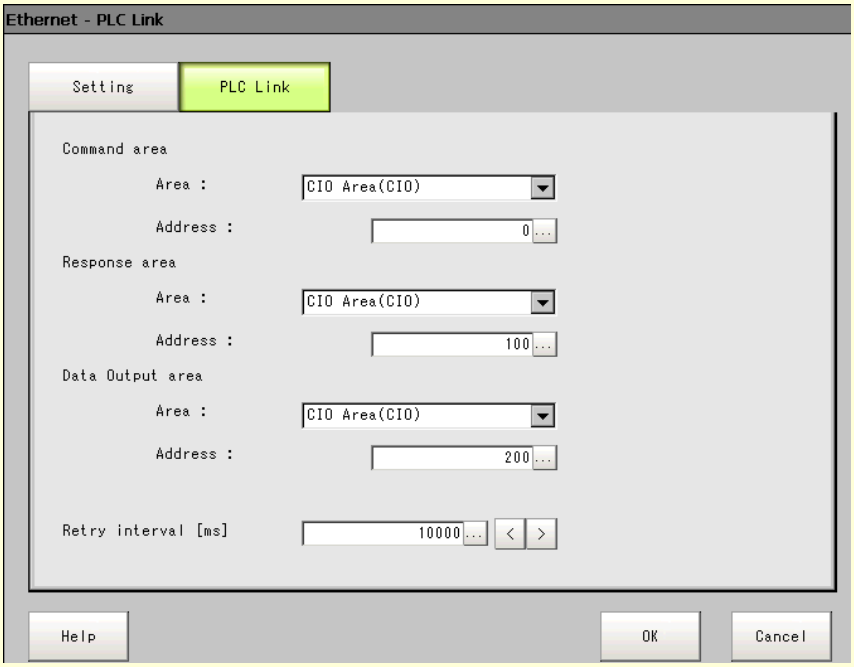


Note For details concerning settings, see the page listed below in the standard FZ3 software User's Manual.

Environment Setting Part > How To Connect & Communicate With External Devices > Communicating through Serial Communication (PLC Link) > Setting Communication Specifications (Ethernet - PLC Link)

6. Select [System] - [Communication] - [Serial] – [Ethernet] - [PLC Link] in the ADJUST mode screen.

Specify the Mitsubishi PLC data register addresses for the Command area, Response area, and Data Output area.



Note If the communication target is a Mitsubishi PLC, data register will be the area setting no matter which area type is picked.

7. Settings will be completed if the [OK] button is pressed and the screen will return to the ADJUST mode screen.

3-2-3 Memory Allocation, Command Control, Data Output, Timing Chart

Other PLC link functions are the same as with the standard FZ3 software.
For information on each function, see the pages listed below in the standard FZ3 User's Manual.

○Memory allocation

Environment Setting Part > How To Connect & Communicate With External Devices > Communicating through Serial Communication (PLC Link) > Memory Allocation (PLC Link)

○Command control

Environment Setting Part > How To Connect & Communicate With External Devices > Communicating through Serial Communication (PLC Link) > Command Control (PLC Link)

○Data output

Environment Setting Part > How To Connect & Communicate With External Devices > Communicating through Serial Communication (PLC Link) > Data Output (PLC Link)

○Timing chart

Environment Setting Part > How To Connect & Communicate With External Devices > Communicating through Serial Communication (PLC Link) > Timing Chart (PLC Link)

3-2-4 Ladder Program Example of PLC Link with Mitsubishi PLC

This section explains a sample ladder program for PLC link communication with a Mitsubishi PLC.
The PLC link areas are set as shown below.

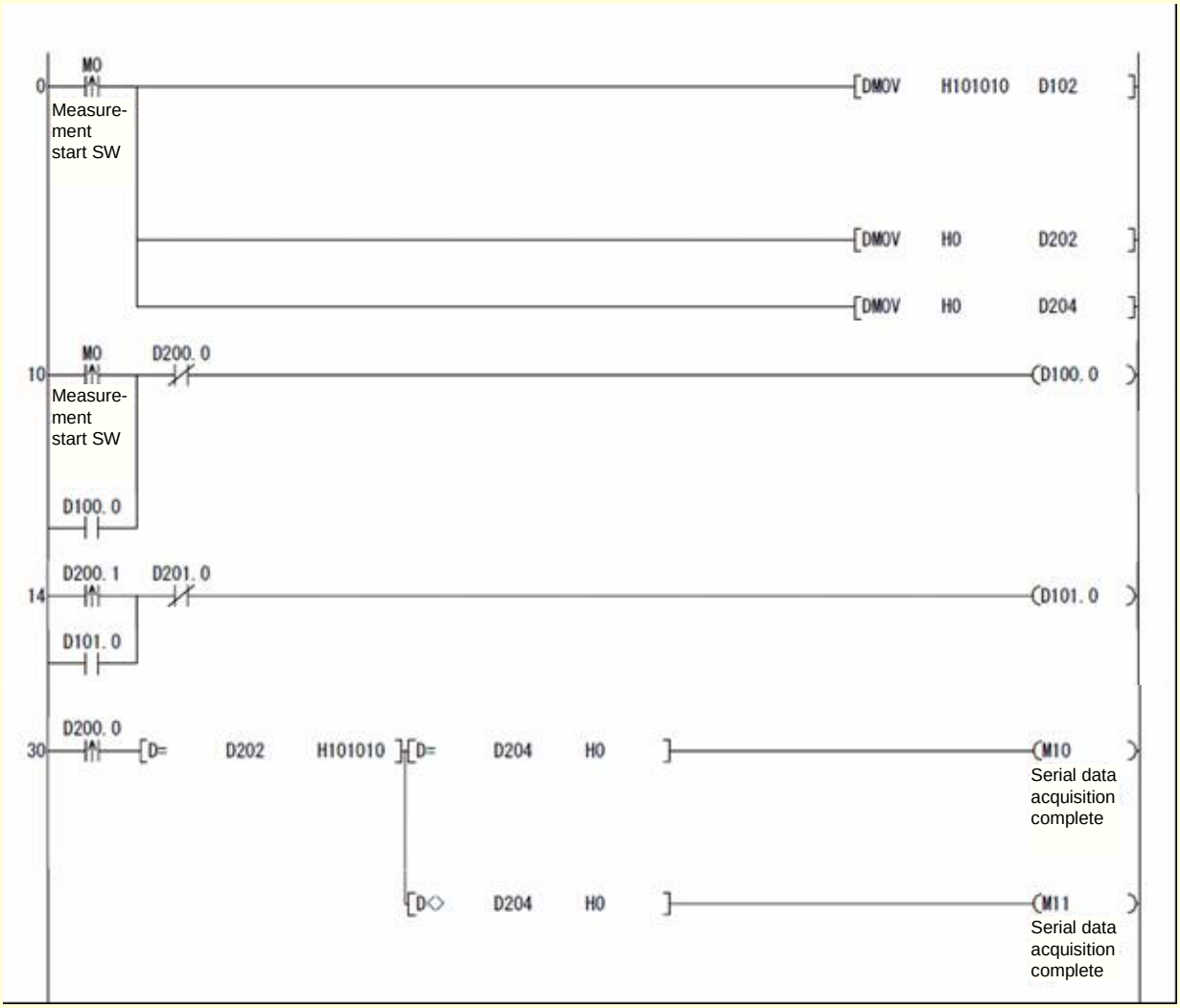
Area	Address
Command area start address	D100
Response area start address	D200
Data output area start address	D1000

The addresses used in this sample ladder program are shown below.

Name	Address	Description
Measurement start SW	M0	Trigger for measurement start
Serial data acquisition complete	M10	Serial data output acquisition completion flag
Serial data acquisition failure	M11	Serial data output acquisition failure flag
CMD_EXE	D100.0	Command execution bit
DSA	D101.0	Data output request bit
Communication command code	D102	PLC link command code
CMD_FLG	D200.0	Command completion bit
BUSY	D200.1	Command execution in progress bit
GATE	D201.0	Data output completion bit
Communication command code	D202	Executed command code
Communication response code	D204	Executed command response code
Data output area	D1000	Data output area

○Ladder program example

After the program has started, the measurement execution command is sent and serial data output is received.



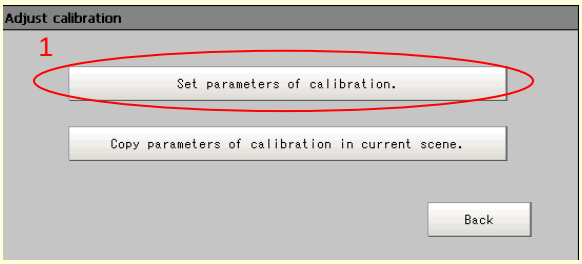
3-3 Calibration Adjustment

This software includes a function by which, with the X-Y-Theta stage or robot coordinate system, calibration can be automatically set just by measuring a reference workpiece multiple times and setting the movement amount.Also, because calibration settings are saved as shared system information, the same calibration settings are easily reflected even in different scenes.

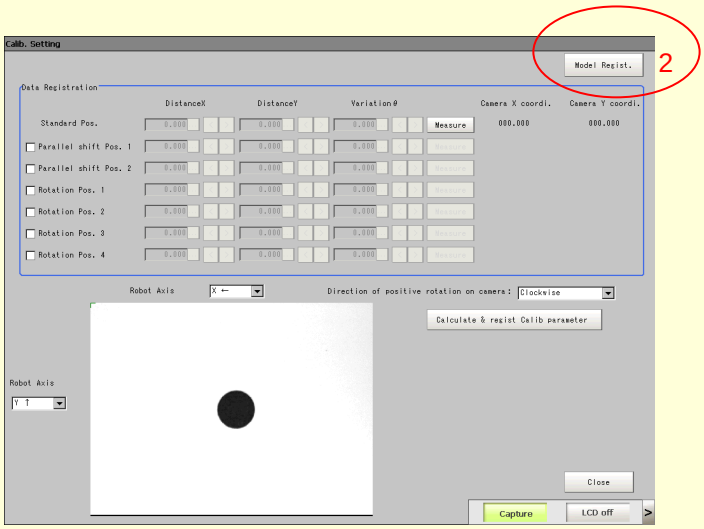
3-3-1 Calib. Setting

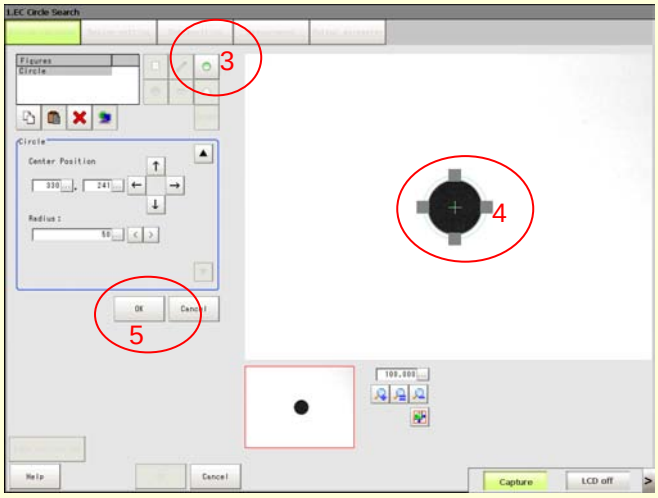
In the system calibration settings, circle marks are used as a reference for measurement. Prepare a reference workpiece that has a circle mark.

1. Select [Camera Setting] - [Adjust calibration] in the ADJUST mode screen.
Tap [Set parameters of calibration.].



2. The system Calib. Setting screen will open.
The camera image will display in a through display. Install the reference workpiece in the settings area and tap the [Model Regist.] button at the upper right.

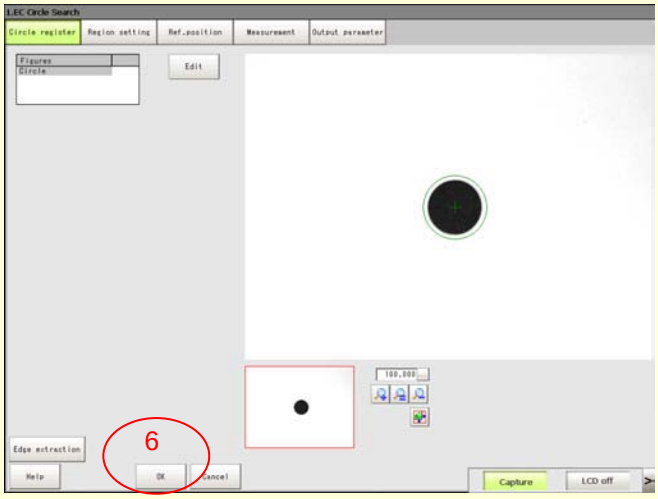




3. Select Circle in the Figures selection.

4. A circular region will be displayed in the screen on the right.
Adjust the circular region to the size of the circle mark.

5. Press the [OK] button.

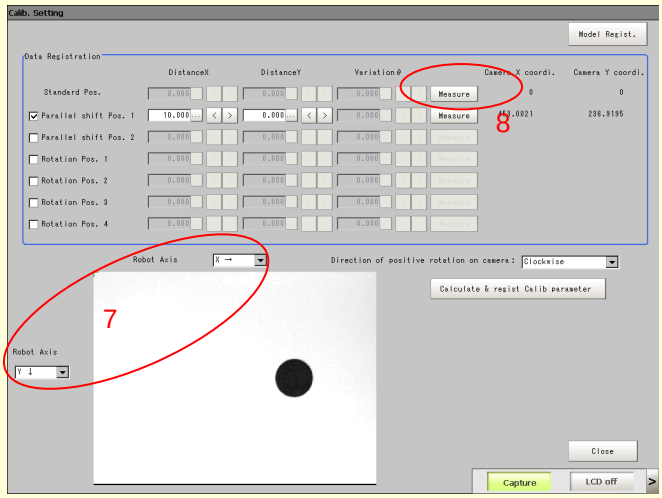


6. Press the [OK] button at the lower left.
The screen returns to the Calib. Setting screen.

Note

Use the EC circle search, which is also included in the standard FZ3 software, for circle mark measurement in the circle setting screen and in calibration.For a detailed description of the settings method, see the page listed below in the standard FZ3 software Processing Items List Manual.

Processing Item List > Inspection and Measurement > EC Circle Search

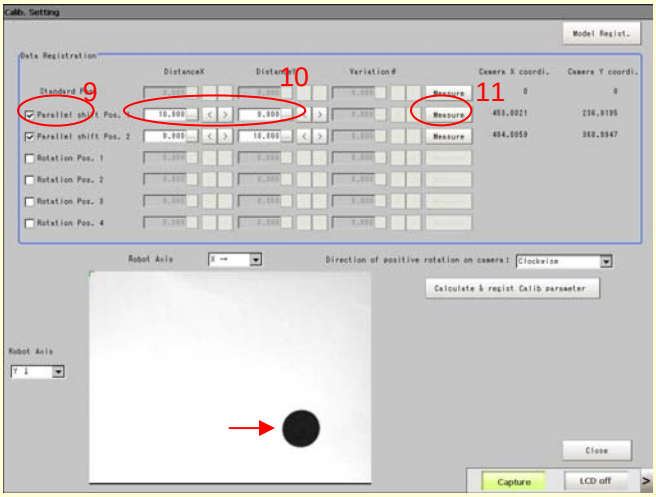


7. Set the X direction and Y direction of the robot axes as they are when viewed from the camera image.

This setting is meant to make stage operation easier for the user. Even if this setting differs from actual conditions, it will not have an effect on calibration calculations.

8. With the stage returned to the origin, press the Measure button on the same row as [Standard Pos.].

The circle mark camera coordinates position will be measured, and the results will be displayed on the right.

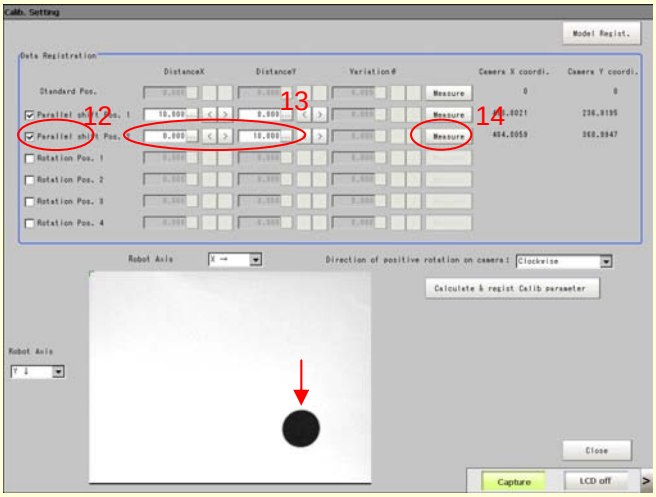


9. Place a check in “Parallel shift Pos. 1” and move the stage in the X direction from the origin (reference position).

10. Input the actual stage movement amount.

11. Tap [Measure] on the same row as “Parallel shift Pos. 1”.

The circle mark camera coordinates position will be measured, and the results will be displayed on the right.

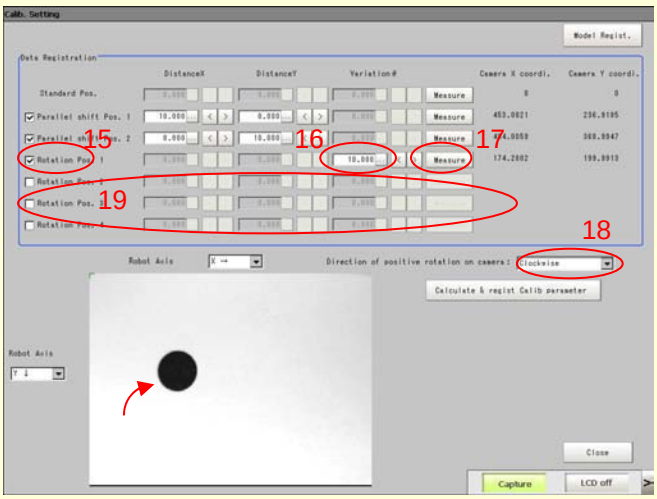


12. Place a check in “Parallel shift Pos. 2” and move the stage in the Y direction from the origin (reference position).

13. Input the actual stage movement amount.

14. Tap [Measure] on the same row as “Parallel shift Pos. 2”.

The circle mark camera coordinates position will be measured, and the results will be displayed on the right.



15. Place a check in “Rotation Pos. 1” and move the stage in the positive theta direction from the origin (reference position).

16. Input the actual stage movement angle.

17. Tap [Measure] on the same row as “Rotation Pos. 1”.

The circle mark camera coordinates position will be measured, and the results will be displayed on the right.

18. Select one of the options in [Direction of positive rotation on camera].

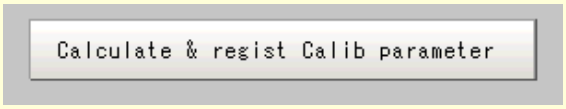
- Clockwise: Selected if the movement direction of the circle mark on the image is clockwise when the stage is moved in the positive theta direction.
- Counterclockwise: Selected if the movement direction of the circle mark on the image is counterclockwise when the stage is moved in the positive theta direction.

19. If necessary, set "Rotation Pos. 2-4" using the same procedure.

Generally, using more points in measurement means that the accuracy of calibration will be better.

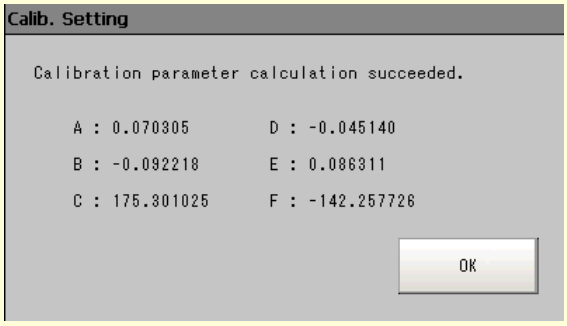
20. After the necessary measurement is completed, tap [Calculate & regist Calib parameter].

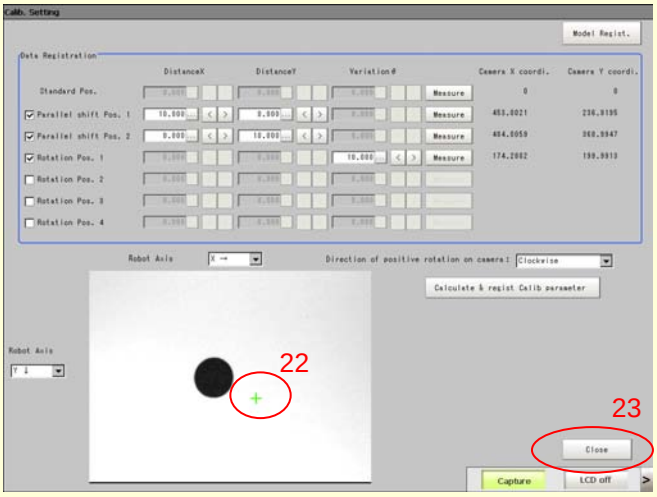
Calculate the stage origin from the measurement coordinates and movement amounts up until the current point and determine the calibration parameters.



21. If calculation of calibration parameters is successful, the screen shown below is displayed.

Tap [OK]. The screen returns to the Calib. Setting screen.





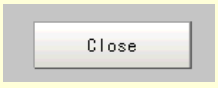
22. The automatically calculated stage origin is displayed with a crosshair cursor.

Check whether this origin matches with the actual stage origin. However, the stage origin will not display if it is outside the area of the image.

23. Tap [Close] to return the screen to the Adjust calibration screen.

24. Tap [Back] in the Adjust calibration screen.

The screen returns to the Camera Setting screen. (page 6)



Note

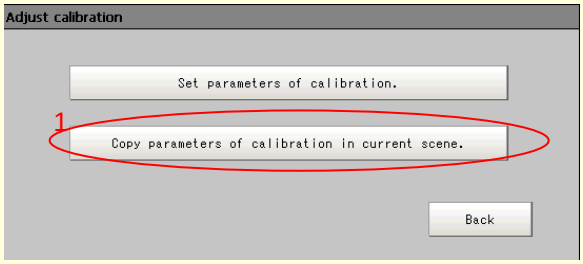
In addition to system calibration setting, calibration setting using camera image input processing items that are included in the standard FZ3 software is also possible. See the page listed below in the standard FZ3 software Processing Items List Manual.

Processing item List > Image Input > Camera Image Input > Calibration Setting (Camera Image Input)

3-3-2 Copying Calibration Settings

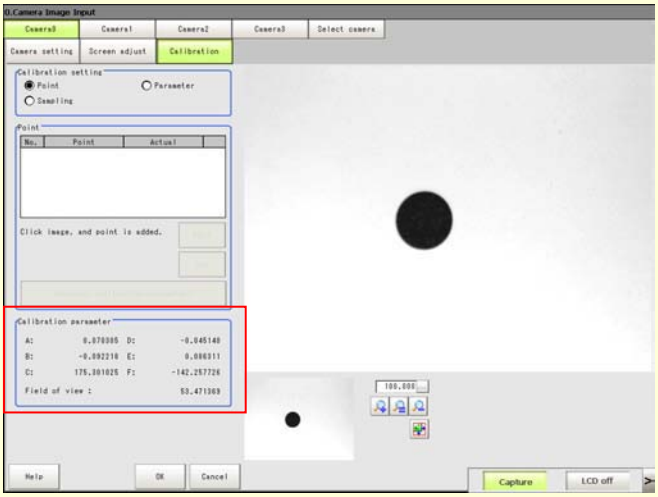
This section explains the procedure for copying the system calibration parameters to the current scene. This function makes it unnecessary to redo calibration settings for each scene.

1. Select [Camera Setting] - [Adjust calibration] in the ADJUST mode screen.
Tap [Copy parameters of calibration in current scene.].



2. If copying is successful, the screen shown below is displayed.
Pressing the [OK] button returns the screen to the Adjust calibration screen.

3. Through this operation, the system calibration parameters are copied to the camera image input unit at the top of the current scene.
This can be confirmed in the screen for [Camera Image Input] - [Calibration].



Note

If flow initialization is performed, the system calibration parameters will automatically be copied.
If the calibration parameters are changed after flow initialization, perform the copy operation.

4-1 Processing Items List

The useable processing items with this software are shown below.

Group	Processing item name	Description	Standard/ Specialized
Inspecting and Measuring	Outline compensation	Detect defects on the cell outline.	Specialized
	Contour alignment	Measures the cell center position and tilting from the cell contour.	Specialized
	Busbar alignment	Measures the cell center position and tilting from the busbars.	Specialized
	Search	For information concerning the standard processing items, see the standard FZ3 Processing Items List Manual.	Standard
	ECM search		Standard
	EC circle search		Standard
	Edge position		Standard
	Number of edge pins		Standard
	Scan edge positions		Standard
	Scan edge width		Standard
	Area gravity center		Standard
	Labeling		Standard
	Label data		Standard
	Fine matching		Standard
Loading images	Camera image input	Loads images from cameras. The only difference with the standard processing unit is that this unit contains rotational polarity (RP) measuring data related to automatic calibration.	Specialized
	Camera switching	For information concerning the standard processing items, see the standard FZ3 Processing Items List Manual.	Standard
	Measurement image switching		Standard
Performing image compensation	Tab Cancel	Deletes tabs around the cell through image correction processing.	Specialized
	Position compensation	For information concerning the standard processing items, see the standard FZ3 Processing Items List Manual.	Standard
	Filtering		Standard
	Background suppression		Standard

Group	Processing item name	Description	Standard/ Specialized
Supporting inspection and measurement	Calculation	For information concerning the standard processing items, see the standard FZ3 Processing Items List Manual.	Standard
	Approximated line		Standard
	Processing unit data setting		Standard
	Processing unit data acquisition		Standard
	Processing unit figure setting		Standard
	Processing unit figure acquisition		Standard
	Trend monitor		Standard
	Image logging		Standard
	Data logging		Standard
	Elapsed time		Standard
	Wait		Standard
Branch control of processing	Conditional branching		Standard
	Measurement completion		Standard
	Input conditional branching		Standard
Externally outputting results	Serial data output		Standard
	Parallel data output		Standard
	Parallel judgement output		Standard
Displaying results on screens/ windows	Results display		Standard
	Image file display		Standard
	Latest NG error image display		Standard

4-2 Alignment Processing Item (About Coordinate Data)

Contour alignment and busbar alignment has two types of XY coordinates data: the center position X, Y coordinates and the X, Y coordinates after rotation correction. (page 32 and page 43) Explain the difference between these two types of data.
If a stage where the rotation center is fixed such as the X-Y-Theta stage is used to perform workpiece position correction, there are cases where correction to the desired reference position for the actual workpiece will not be possible with one performance of position correction as shown in Figure 1.

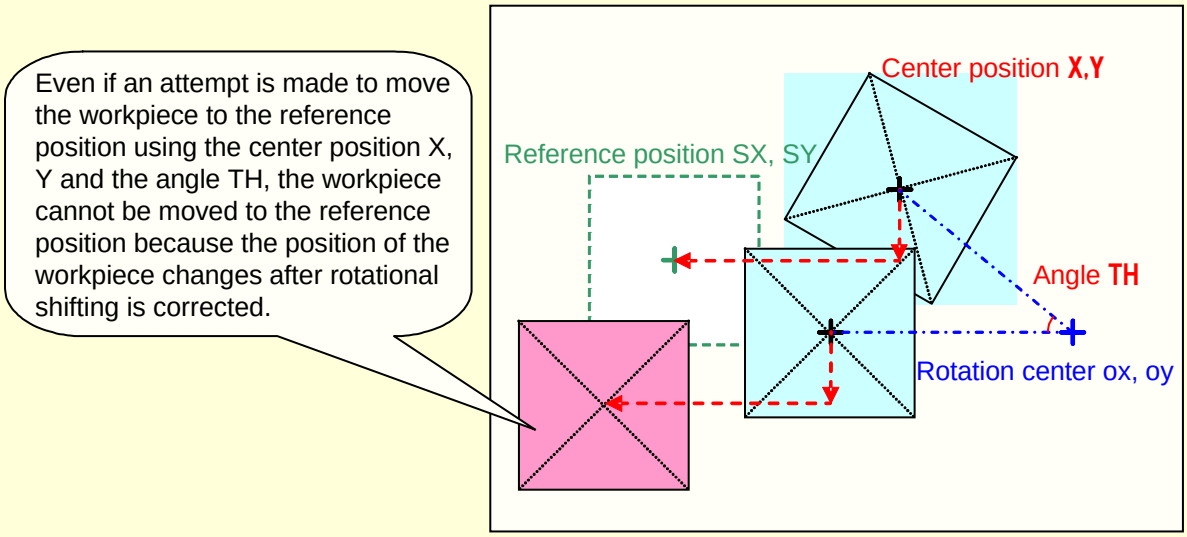

Even if an attempt is made to move the workpiece to the reference position using the center position X, Y and the angle TH, the workpiece cannot be moved to the reference position because the position of the workpiece changes after rotational shifting is corrected.
Center position X,Y
Reference position SX, SY
Angle TH
Rotation center ox, oy

Figure 1. Position correction failure example

Therefore, by determining the “coordinates after rotation correction” after the workpiece position is corrected by only the rotational shifting amount, the workpiece position can be corrected by performing position correction one time as shown in Figure 2 so that it is at the desired reference position.

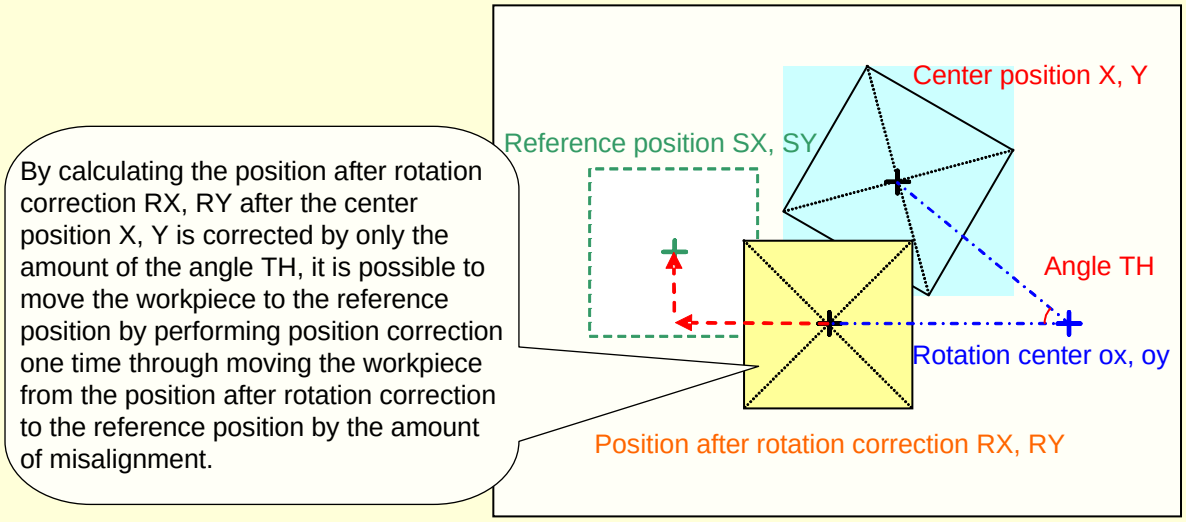

By calculating the position after rotation correction RX, RY after the center position X, Y is corrected by only the amount of the angle TH, it is possible to move the workpiece to the reference position by performing position correction one time through moving the workpiece from the position after rotation correction to the reference position by the amount of misalignment.
Center position X, Y
Reference position SX, SY
Angle TH
Rotation center ox, oy
Position after rotation correction RX, RY

Figure 2. Position correction using the position after rotation correction

Note In position correction using the X-Y-Theta stage where the rotation center is fixed, use the position after rotation correction RX, RY. In position correction using the robot stage where the rotation center is not fixed, use the center position X, Y.

5. Revision History

Date	Contents	Page
2009/7/10	First edition	—
2012/7/20	Compatible controllers are changed.	4

OMRON Corporation Industrial Automation Company
Tokyo, JAPAN

Contact: www.ia.omron.com

Regional Headquarters
OMRON EUROPE B.V.
Wegalaan 67-69-2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
One Commerce Drive Schaumburg,
IL 60173-5302 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

© OMRON Corporation 2009 All Rights Reserved.
In the interest of product improvement,
specifications are subject to change without notice.

Cat. No. Z293-E1-02